NAVPERS 15779

Catalogue of UNITED STATES NAVAL POSTGRADUATE SCHOOL

ACADEMIC YEAR

1948 • 1949

POST GRADUATE SCHOOL ANNAPOLIS, MARYLAND

NAV PERS 15779

CATALOGUE OF
U. S. NAVAL POSTGRADUATE SCHOOL
UNITED STATES NAVAL ACADEMY

ACADEMIC YEAR

1948 - 1949

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PART I

GENERAL

STAFF OF THE NAVAL POSTGRADUATE SCHOOL

Officers

H. A. Spanagel	Capt. USN	Superintendent
J. M. P. Wright	Capt. USN	Executive Officer

Aerological Engineering

W. E. Oberholtzer	Capt. AEDO USN	Officer in Charge
P. T. Jorgensen	Lt. Cdr. AEDO USN	
M. C. Jack	Lt. Cdr. AEDO USN	
M. A. Eaton	Lieut. AEDO USN	
L. D. From	Ch. Aero. USN	

Aeronautical Engineering

W. W. Hollister	Cmdr. USN	Officer in Charge

Applied Communications

W. L. Dye	Capt. USN	Officer in Charge
J. H. Fortune	Cmdr. USN	
A. P. Zavadil	Cmdr. USN	
A. G. Harrison	Lt. Cdr. USN	

Electronics Engineering

J. L. Melgaard	Capt. USN	Officer in Charge
H. V. Wardlow	Cmdr. USN	
G. J. Stetka	Lt. j.g. USN	

Naval Engineering

J. E. Fradd	Capt. USN	Officer in Charge
D. R. Frakes	Cmdr. USN	
J. P. Craft	Cmdr. USN	

Ordnance Engineering

E. K. Walker	Capt. USN	Officer in Charge
S. M. Archer	Cmdr. USN	
C. W. Travis	Cmdr. USN	

S. H. Werner	Lt. Cdr. USN	Aide to Executive Officer
L. S. Helmeci	Lt. j.g. USN	Comm. Officer

CIVILIAN FACULTY

Wilkinson, Ford L. Jr., B.S., M.S., D. Eng. (Hon.)	Academic Dean
Root, Ralph E., B.S., M.S., Ph. D.	Senior Prof. of Mathematics (Emeritus)
Fowler, Harold E., AB.; B.L.S.	Librarian

Aerology

Duthie, William D., B.A., M.S., Ph. D.	Chairman; Prof. of Aerology
Haltiner, George J., B.S., Ph. D., Ph. M.	Asst. Prof. of Aerology
Martin, Frank L., B.A., M.A., Ph. D.	Asst. Prof. of Aerology

Aeronautics

Coates, Wendell M., A.B., M. Sc., D. Sc.	Chairman; Prof. of Aeronautics
Borg, Sidney F., B.S. in C.E., M.C.E.	Asst. Prof. of Aeronautics
Dennis, Ward B., B. Ac. E., M.S.E. (Ae).	Asst. Prof. of Aeronautics
Higgins, George J., B.S. in Eng. (Ae.E.), Ae.E.	Prof. of Aeronautics
Kahr, Charles H., B.S. (AeE), M.S.E. (Ae).	Asst. Prof. of Aeronautics
Kohler, Henry L., B.S., M.S., M.E.	Assoc. Prof. of Aeronautics
Rottmeyer, Earl, B.S.M.E., M.S.E. (Ae).	Asst. Prof. of Aeronautics
Varva, Michael H.,.Dipl. Ing.	Assoc. Prof. of Aeronautics

Electrical Engineering

Terwilliger, Charles V.O., B.E., M.S. in E.E., Dr. Eng.	Chairman; Prof. of Electrical Engineering
Oler, Charles B., B.S., M.S.	Asst. Prof. of Electrical Engineering
Polk, Orval H., B.S. in E.E., E.E., M.S.	Assoc. Prof. of Electrical Engineering

Electrical Engineering (Con't.)

Smith, W. Conley, B.S. in E.E., M.S.	Asst. Prof. of Electrical Engineering
Vivell, Allen, E., B.E., Dr. Eng.	Prof. of Electrical Engineering
Wheeler, Richard C.H., B.E., D. Eng.	Prof. of Electrical Engineering

Electronics and Physics

Frey, Austin R., B.S., S.M., Ph. D.	Chairman; Prof of Physics
Bauer, Robert E., B.S.	Asst. Prof. of Electronics
Bauer, William M., B.S., E.E., M.S. in E.E., S.D.	Assof. Prof of Electronics
Chaney, Jessee G., A.B., M.A.	Prof. of Electronics
Cunningham, William P., B.S., Ph. D.	Assoc. Prof of Physics
Cooper, Paul E., B.S., M.S.	Asst. Prof. of Electronics
Giet, G. Robert, A.B., E.E.	Prof. of Electronics
Goddard, Earl G., B.S. in E.E., M.A., E.E.	Asst. Prof. of Electronics
Healy, Daniel W., B.S., M.A. (on leave)	Asst. Prof. of Electronics
Hunter, George T., B.S., M.S.(on leave)	Asst. Prof. of Electronics
Kalmbach, Sydney H., B.S., M.S.	Asst. Prof. of Physics
Kinsler, Lawrence E., B.S., Ph. D.	Assoc. Prof. of Physics
Koehler, Wilfert F., B.S., M.A.	Assoc. Prof. of Physics
Maling, Henry F., B.S., S.M., S.D.	Asst. Prof. of Electronics
Menneken, Carl E., B.S., M.S.	Assoc. Prof of Electronics
Miller, Robert L., B. Ed., M.S.	Asst. Prof. of Electronics
Oleson, N.L. A.B., Ph. D.	Assoc. Prof. of Electronics

Electronics and Physics (Con't.)

Roadstrum, William H., B.S. in E.E., M.S. in E.E.	Asst. Prof. of Electronics
Sheingold, Abraham, B.S., M.S.	Asst. Prof. of Electronics
Wilson, Robert D., B.S. (on leave)	Instructor in Electronics

Mathematics and Mechanics

Church, W. Randolph, A.B., A.M., Ph. D.	Chairman; Prof of Math. & Mech.
Bleick, Willard E., M.E. Ph. D.	Assoc. Prof. of Math. & Mech.
Campbell, Richard C., B.S., A.M.	Asst. Prof. of Math. & Mech.
Denbow, Carl H., S.S., S.M., Ph. D.	Assoc. Prof. of Math. & Mech.
Giarratana, Joseph, B.S., Ph. D.	Assoc. Prof. of Math. & Mech.
Jennings, Walter, B.A., B.S., M.A.	Asst. Prof. of Math. & Mech.
Mewborn, A. Boyd, A.B., M.S., Ph. D.	Assoc. Prof. of Math. & Mech.
Rawlins, Charles H., Ph. B., A.M. Ph. D.	Prof. of Math. & Mech.
Ritter, Eugene K., B.A., M.A.	Assoc. Prof. of Math. & Mech.
Torrance, Charles C., M.E., M.A., Ph. D.	Assoc. Prof. of Math. & Mech.

Mechanical Engineering

Kiefer, Paul J., A.B., B.S. in M.E., M.E.	Chairman; Senior Prof. of Mech. Eng.
Gatcombe, Ernest K., B.S. in M.E., M.S. in M.E. Ph. D.	Assoc. Prof. of Mech. Eng.
Kavanaugh, Dennis, B.S. in M.E.	Prof. of Mech. Eng.
Lee, George H., B.S., M.S. in Eng., Ph. D.	Assoc. Prof. of Mech. Eng.
Prowell, Roy W., B.S. in Indus. Eng'g., M.S. in M.E.	Asst. Prof. of Mech. Eng.
Wright, Harold M., B.S. in M.E., M.M.E.	Assoc. Prof. of Mech. Eng.

Metallurgy and Chemistry

Coonan, Fredrick L., A.B., M.S., D. Sc.	Chairman; Prof. of Metal. & Chem.
Buerger, Newton W., S.B., S.M., Ph. D.	Assoc. Prof. of Metal.
Clark, John R., B.S., Sc. D.	Assoc. Prof. of Metal.
Hering, Carl A., B.S. in Ch. E., M.S. in Eng.	Asst. Prof. of Chem. Eng.
Kinney, Gilbert F., A.B., M.S., Ph. D.	Assoc. Prof. of Chem. Eng.
Marshall, George D. Jr., B.S., M.S.	Assoc. Prof. of Metal.
Mebane, William M., B.S., M.S., Ph. D.	Assoc. Prof. of Chemistry
Reynolds, Melvin F., B.S., M.S., Ph. D.	Assoc. Prof. of Chemistry

ACADEMIC ASSOCIATES

Aeorlogical Engineering	
William D. Duthie, B.A., M.S., Ph.D.	Prof. of Aerology
Aeronautical Engineering	
Wendell M. Coates, A.B., M.Sc., D.Sc.	Prof. of Aeronautics
Applied Communications	
G. Robert Giet, A.B., E.E.	Prof. of Electronics
Electronics Engineering	
G. Robert Giet, A.B., E.E.	Prof. of Electronics
General Line School	
Frank E. La Cauza, B.S. in E.E., M.S. in E.E., A.M.	Prof. of Electrical Eng.
Naval Engineering	
Orval H. Polk, B.S. in E.E., E.E., M.S.	Assoc. Prof. of Electrical Eng.
Ordnance Engineering	
Richard C. H. Wheeler, B.S., D.Eng.	Prof. of Electrical Eng.

TERM WEEKLY CALENDAR 1948 - 1949

Week	Summer	Fall	Winter	Spring
1st	July 26	Oct. 11	Jan. 3	Mar. 21
2nd	Aug. 2	Oct. 18	Jan. 10	Mar. 28
3rd	Aug. 9	Oct. 25	Jan. 17	Apr. 4
4th	Aug. 16	Nov. 1	Jan. 24	Apr. 11
5th	Aug. 23	Nov. 8	Jan. 31	Apr. 18
6th	Aug. 30	Nov. 15	Feb. 7	Apr. 25
7th	Sept. 6	Nov. 22	Feb. 14	May 2
8th	Sept. 13	Nov. 29	Feb. 21	May 9
9th	Sept. 20	Dec. 6	Feb. 28	May 16
10th	Sept. 27	Dec. 13	Mar. 7	May 23
11th	Oct. 4	- - - -	Mar. 14	- - - -

Christmas Leave Period: December 18, 1948 - January 2, 1949

Field Trips: May 31 - July 9, 1949

Intersessional Leave Period: July 10 - July 24, 1949

The following days have been designated holidays and no classes will be held:

6	September	1948	Monday
11	November	1948	Thursday
25	November	1948	Thursday
25	December	1948	Saturday
1	January	1949	Saturday
22	February	1949	Tuesday
30	May	1949	Monday
4	July	1949	Monday

GENERAL PLAN OF EDUCATION IN THE NAVY AS PERTAINS TO THE POSTGRADUATE SCHOOL

The general plan for officer education is set forth in the Bureau of Navigation letter No. NC4/P11-1(866) 4 March 1939 pertinent parts of which are quoted below.

"(a) Officers will be selected from the candidates and in accordance with the Personnel Plan of the Navy which designates the numbers to be given instruction in each curriculum, and in accordance with the officer's aptitude for the particular course of instruction as proven by his past record*****.

(b) The various curriculums will include, first, all necessary subjects that will contribute to the primary objective in the development of specialties in design, inspection, installation of material, and attendant research problems, and second, such of the subjects taught in the General Line curriculum as can be included without detriment to the primary objective."

THE REGULATIONS GOVERNING THE POSTGRADUATE SCHOOL

The Naval Postgraduate School was originally established in 1909 at the direction of the Navy Department as an activity of the U. S. Naval Academy at Annapolis. In 1947 it was established as the U. S. Naval Postgraduate School and became a separate activity in accordance with Public Law 303 - 80th Congress - 1st Session, quoted in part as follows:-

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Navy is hereby authorized and directed to establish the United States Naval Postgraduate School for the advanced instruction and training of commissioned officers of the Regular Navy and Marine Corps and the reserve components therof in the practical and theoretical duties of commissioned officers.

The military command of the United States Naval Postgraduate School (hereinafter referred to as the postgraduate school) shall be exercised by a line officer of the Regular Navy, qualified to command at sea, detailed by the Secretary of the Navy, from the active list not below the grade of captain to serve as Superintendent. Such other officers of the line and staff of the Navy and Marine Corps, of appropriate ranks and qualifications, shall be detailed by the Secretary of the Navy as may be necessary to assist the Superintendent in (a) the training of students in the practical and theoretical duties of commissioned naval officers, and (b) the administration of the postgraduate school.

The Secretary of the Navy is authorized to employ at the postgraduate school, under the direction of the Superintendent, such number of civilian senior professors, professors, associate professors, assistant professors, and instructors, as in his opinion may be necessary for the proper instruction of students in the theoretical, academic, and scientific subjects pertaining to the technical and practical aspects of the naval profession; and such senior professors, professors, associate and assistant professors, and instructors so employed shall receive such compensation for their services as may be prescribed by the Secretary of the Navy. The Secretary of the Navy shall report to the Congress each fiscal year the number of senior professors, professors, associate and assistant professors, and instructors so employed and the amount of compensation prescribed for each. The Act of January 16, 1936 (49 Stat. 1092), as amended by the Acts of November 28, 1943 (57 Stat. 594), and August 2, 1946 (Public Law 596, Seventy-Ninth Congress, second session), shall apply to the civilian teaching staff of the postgraduate school.

The Act of June 10, 1946 (Public Law 402, Seventy-ninth Congress, second session), creating the civilian position of Academic Dean of the Postgraduate School of the Naval Academy shall apply to the postgraduate school established by this Act.****

The Secretary of the Navy is authorized, at the request of the Secretary of War and the Secretary of the Treasury, to permit attendance and instruction at the postgraduate school of officers of the Army of the United States and United States Coast Guard, respectively, in such numbers and ranks as may be agreed upon by the Secretary of the Navy with the Secretaries of War and Treasury, respectively: Provided, That the War Department and the Treasury Department shall bear the proportionate share of the cost of such instruction as may be received by the students detailed to receive such instruction by the Secretaries of War and Treasury, respectively. Such officers of the Army of the United States and the United States Coast Guard, while under instruction, shall be subject to the same rules and regulations as are applied to students of the United States Navy.

The title of the Act approved December 7, 1945 (Public Law 250, Seventy-ninth Congress, first session), is hereby amended to read as follows: 'To authorize the Superintendent of the United States Naval Postgraduate School to confer bachelors of science, masters, and doctors degrees in engineering and related fields'. Section 1 of the foregoing Act is hereby amended to read as follows: 'That, pursuant to such regulations as the Secretary of the Navy may prescribe, the Superintendent of the United States Naval Postgraduate School is authorized, upon due accreditation from time to time by the appropriate professional authority of the applicable curriculum of such school leading to bachelors of science, masters or doctors degrees in engineering or related fields, to confer such degree or degrees on qualified graduates of such school."

There is hereby authorized to be appropriated such amounts as may be necessary for the postgraduate school to carry out its functions as provided herein."

In addition to the School at Annapolis, which is primarily for Engineering student officers. The Superintendent is responsible for an Intelligence School in Washington, D. C. and General Line Schools at Newport, R. I. and Monterey, California. Plans are being developed for the eventual centralization of all the above schools in Monterey.

REGULATIONS GOVERNING THE AWARD OF ADVANCED DEGREES

1. Master's or Doctor's degrees in engineering or related fields may be awarded by the Superintendent of the United States Naval Postgraduate School upon recommendation of the Faculty based upon satisfactory completion of a course of advanced study arranged by a Curriculum Committee, approved by the Academic Council (consisting of the Academic Dean, the Director of the School of Engineering and the civilian Heads of the Academic Departments) and complying with the regulations set forth hereunder.

2. The Master's Degree:

(a) The curriculum which complements the basic scientific education of the student, meets the needs of the Navy, and includes a course of advanced study leading to the Master's degree shall require a minimum residence of two academic years.

(b) The course of advanced study shall comprise not less than thirty-two semester hours of work regarded by the Academic Council as clearly of graduate level. At least four hours shall be in advanced mathematics. One hour of classroom or two hours of laboratory work (or the equivalent) shall equal one semester hour.

(c) Candidacy to and eligibility for a Master's degree shall be determined as follows:

(1) An X (failure) in a course carrying any graduate credit will automatically disqualify a candidate for a degree.

(2) Each successful candidate must attain a quality point rating of 2.0 or greater in all courses of a curriculum that carry any graduate credit.

(3) Each successful candidate must attain a quality point rating of 1.5 or greater in all courses of his U. S. Naval Postgraduate School curriculum other than those carrying graduate credit.

(4) Quality Point Rating will be determined in the following manner:

Grade	Quality Points
A	3.0
B	2.0
C	1.0
D	0
X	-1.0

The Quality Point Rating shall be calculated by dividing the sum of the products of assigned quality points and credit hours in each course by the total number of credit hours obtained. Each one hour lecture or recitation period per week or each two hour laboratory or P.W. period will count as one credit hour.

(5) No student shall be admitted to candidacy for the Master's degree, except by special permission of the Academic Council, unless he has attained a Quality Point Rating of not less than 1.75 in all courses of his curriculum carrying any graduate credit by the beginning of that term which marks the completion of at least three-fourths of his graduate credit courses.

(d) A reasonable proportion of the graduate level work shall comprise (1) research and a thesis reporting the result thereof, or (2) research and submission of an acceptable accomplishment in advanced design work, or (3) successful completion of suitable courses in research methods. The student may be required to pass an oral examination either in defense of his thesis or upon the basic technology of his major field.

3. The Doctorate:

(a) The curriculum which meets the needs of the Navy and includes a course of advanced study leading to the Doctor's degree shall require the equivalent of at least three academic years of work beyond the undergraduate level. The student shall spend not less than one academic year at the Postgraduate School in studies which are definitely a part of his doctorate work.

(b) A least one year prior to the anticipated granting of the degree the student, to validate his candidacy, shall pass creditably an oral and written examination covering the fields which support the field of his proposed research and he shall show proof of a technical reading knowledge of two approved foreign languages.

(c) The candidate's work shall be done with the counsel of a Special Committee and under the immediate supervision of a competent director designated thereby. It shall include a publishable dissertation reporting the results of original research, accomplished in residence or elsewhere. It shall be of exceptionally meritorious character.

(d) The candidate whall pass creditably a final oral examination over the major field of specialization and in defense of his dissertation.

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MISSION

From the above regulations, the mission of the Postgraduate School is taken to be:

TO CONDUCT AND DIRECT THE ADVANCED INSTRUCTION AND TRAINING OF COMMISSIONED OFFICERS IN THE PRACTICAL AND THEORICAL DUTIES IN ORDER TO MEET THE REQUIREMENTS OF THE NAVY.

TASK

TASK: 1. To provide the advanced education necessary for selected groups of officers to develop proficiency in design, inspection and installation of material, with attendant research problems, and to provide practical and theoretical training necessary for officers to serve in special branches of the Naval service by:

(a) Planning, conducting and maintaining suitable postgraduate courses at the U. S. Naval Postgraduate School, Annapolis, Maryland, and at selected civilian institutions.

(b) Organizing, planning and directing General Line curricula at Newport, Rhode Island, and Monterey, California.

(c) Organizing, planning and directing the conduct of a Naval Intelligence course at Naval School (Naval Intelligence), Receiving Station, Washington, D. C.

DEFINITIONS

Before setting forth the duties of the various members of the Staff, certain terms as used at the Postgraduate School are defined.

A CURRICULUM is a general program of study which extends over one or more years.

A SUBJECT is the organized body of knowledge such as Mathematics, Mechanics, Chemistry, etc. forming a study. For purpose of brevity each subject is assigned a letter.

A COURSE is a subdivision of a SUBJECT, selected and arranged for a particular purpose. For purposes of brevity each COURSE is assigned the letter of the SUBJECT to which it pertains together with its own individual number, such as M-101, M-312, etc. Each subject matter designation will be followed by a course number symbol containing three digits, the first digit indicating the field within the subject, the second digit to be zero unless needed to further qualify the field, and the third digit to indicate a sequence in the field. The second digit may be important in designating courses of different levels, such as is at present found in Mathematics.

A GROUP is a collection of student officers who receive the same instruction. For purposes of brevity each GROUP is assigned a letter. These should not be confused with letters assigned SUBJECTS.

A SCHEDULE OF INSTRUCTION shows the COURSES taken by any one GROUP during each term.

STUDENT OFFICERS OF THE POSTGRADUATE SCHOOL

Board of officers meeting yearly in Washington select student officers to take the curriculums at the Postgraduate School in Annapolis, the combined Naval Engineering and Naval Construction curriculum at Mass. Inst. of Tech., the Civil Engineering curriculum at Rensselaer Polytechnic Inst., the Law, Textile Engineering, Business Administration, Personnel Administration and Training, Advanced Management, and Industrial Management curriculums at various other universities. The organization for those selected who are to commence their postgraduate instruction at the institutions away from Annapolis is shown in Part IV. For those to enter the Postgraduate School at Annapolis the organization is as shown below.

ORGANIZATION

Group Designation	Year of Instruction		
A	1st	Postgraduate School	Aeronautical Eng.
A2	2nd	Postgraduate School	" "
A3	3rd	U. of Michigan	" "
AC3	3rd	Cal Tech & U. of Minn.	Compressibility
AJ3	3rd	Cal Tech & U. of Minn.	Jet Propulsion
AP3	3rd	M. I. T.	Propulsion Systems
AR	1st	Postgraduate School	Aero. Eng. Arm.
AR2	2nd	Postgraduate School	" " "
AR3	3rd	M. I. T.	" " "
AS3	3rd	Cal Tech & U. of Minn.	Structures
AT3	3rd	Rensselaer Poly. Inst.	Gas Turbines
C10	1st	Postgraduate School	App. Communications
E	1st	Postgraduate School	Electronics Eng.
E2	2nd	Postgraduate School	" "
E3	3rd	Postgraduate School	" "
EA	1st	Postgraduate School	Elect. Eng. (Aeron)
EA2	2nd	Postgraduate School	" " "

EW3	3rd	U. C. L. A.	Electronics Eng.
N	1st	Postgraduate School	Nav. Engineering
N2	2nd	Postgraduate School	" "
N3	3rd	Postgraduate School	" "
NA	1st	Postgraduate School	" " (Applied)
NA2	2nd	Postgraduate School	" " "
NC	1st	Postgraduate School	Chemical Eng.
NC2	2nd	Lehigh Univ.	" "
NC3	3rd	Lehigh Univ.	" "
NH	1st	Postgraduate School	Mechanical Eng.
NH2	2nd	Postgraduate School	" "
NH3	3rd	Postgraduate School	" "
NJ	1st	Postgraduate School	Nav. Eng. (Gas Turbine)
NJ2	2nd	Postgraduate School	" " " "
NJ3	3rd	Selected Univ.	" " " "
NL	1st	Postgraduate School	Electrical Eng.
NL2	2nd	Postgraduate School	" "
NL3	3rd	Postgraduate School	" "
NM	1st	Postgraduate School	Metallurgical Eng.
NM2	2nd	Carnegie Tech.	" "
NM3	3rd	Carnegie Tech.	" "
NN	1st	Postgraduate School	Nuclear Power Eng.
NN2	2nd	Postgraduate School	" " "
NN3	3rd	Argonne Laboratories	" " "
NP	1st	Postgraduate School	Petroleum Eng.
NP2	2nd	Univ. of Calif.	" "
NP3	3rd	Univ. of Calif.	" "
O	1st	Postgraduate School	Ord. Eng. (General)
O2	2nd	Postgraduate School	" " "
O3	3rd	Purdue Univ.	" " "

OC	1st	Postgraduate School	Ord. Eng. (Fire Con)
OC2	2nd	M. I. T.	" " " "
OC3	3rd	M. I. T.	" " " "
OE	1st	Postgraduate School	Ord. Eng. (Aviation)
OE2	2nd	Postgraduate School	" " "
OE3	3rd	M. I. T.	" " "
OG	1st	Postgraduate School	Guided Mis. Guidance
OG2	2nd	Postgraduate School	" " "
OG3	3rd	Institution Selected	" " "
OJ	1st	Postgraduate School	Ord. Eng. (Jet Prop)
OJ2	2nd	Postgraduate School	" " " "
OJ3	3rd	Institution Selected	" " " "
OM	1st	Postgraduate School	Ord. Eng. (Metall.)
OM2	2nd	Postgraduate School	" " "
OM3	3rd	Carnegie Tech.	" " "
OP	1st	Postgraduate School	Ord. Eng. (Chemical)
OP2	2nd	Postgraduate School	" " "
OP3	3rd	Institution Selected	" " "
OR	1st	Postgraduate School	Ord. Eng. (GM-Electronic)
OR2	2nd	Postgraduate School	" " " "
OR3	3rd	M. I. T.	" " " "
OT	1st	Postgraduate School	Ord. Eng. (Mech-Elec Propulsion)
OT2	2nd	Postgraduate School	" " " "
OT3	3rd	M. I. T.	" " " "
OW	1st	Postgraduate School	Ord. Eng. (Subsurface)
OW2	2nd	Postgraduate School	" " "
OW3	3rd	U. C. L. A.	" " "
OX	1st	Postgraduate School	Ord. Eng. (Sp. Phys)
OX2	2nd	M. I. T.	" " " "
OX3	3rd	M. I. T.	" " " "

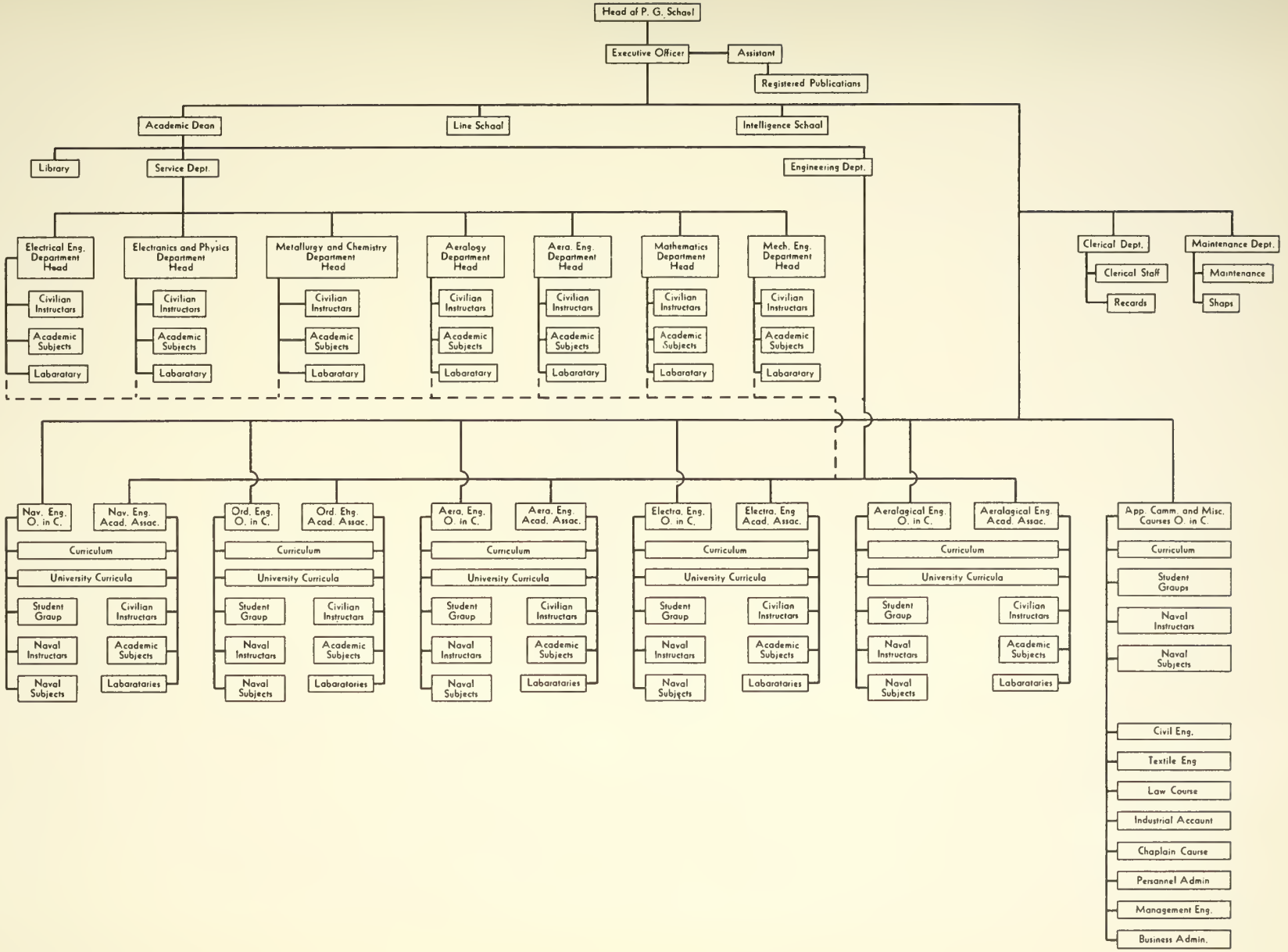
R	1st	Postgraduate School	Atomic Energy Eng. (General Atomic Energy)
R2	2nd	Institution Selected	" " "
RM	1st	Postgraduate School	Atomic Energy Eng. (Radiological Defense)
RM2	2nd	Institution Selected	" " "
RM3	3rd	Institution Selected	" " "
RX	1st	Postgraduate School	" " "
RX2	2nd	Institution Selected	" " "
RX3	3rd	Institution Selected	" " "
RZ	1st	Postgraduate School	" " "
RZ2	2nd	Univ. of Calif.	" " "
RZ3	3rd	Univ. of Calif.	" " "

OFFICIALS IN CHARGE OF THE PRESENTATION OF CURRICULA OF POSTGRADUATE STUDENT OFFICER GROUPS AT UNIVERSITIES

GROUP	UNIVERSITY	IN CHARGE
A3 Aero. Eng.	Univ. of Michigan	Pro. E. W. Conlon
AC3 AJ3 Aero. Eng. AS3	Cal. Inst. Tech.	Dr. E. E. Sechler
AC3 AJ3 Aero. Eng. AS3	Univ. of Minn.	Pro. J. D. Ackerman
AP3 Aero Eng. Prop. Syst.	M. I. T.	Pro. C. F. Taylor
AR3 Aero Eng. Arm.	M. I. T.	Dr. J. S. Newell
AT3 Aero Eng. (Gas Turb)	R. P. I.	Pro. N. P. Bailey
EW3 Electronic Eng.	U. C. L. A.	Dr. V. O. Knudson
NB Const. Eng.	M. I. T.	Cdr. E. C. Holtzworth
NC Chemical Eng.	Lehigh Univ.	Dr. A. A. Neville
NJ Jet Propulsion	Rensselaer Poly. I.	Pro. N. P. Bailey
NM Metallurgical Eng.	Carnegie Inst. Tech.	Asso. Pro. J. W. Ludewig
NP Petroleum Eng.	Univ. of Calif.	Pro. L. C. Uren
OC2, OC3 Ord. Fire Con.	M. I. T.	Pro. H. L. Hazen
OE3 Ord. (Aviation)	M. I. T.	Dr. J. S. Newell
OG3 GM guidance	M. I. T.	Dr. C. S. Draper
OG3 GM guidance	Johns Hopkins	Dr. W. B. Kouwenhoven
OJ2 Ord. Jet Prop.	Cal. Inst. Tech.	Dr. E. E. Sechler
OJ2 Ord. Jet Prop.	Rensselaer Poly I.	Pro. N. P. Bailey
OM2, OM3 Ord. Metallurgy	Carnegie Inst. Tech.	Asso. Pro. J. W. Ludewig
OP2, OP3 Ord. Explosives	Cornell University	Dr. S. C. Hollister
OR2, OR3 Ord. Elect.	M. I. T.	Pro. E. A. Guillemin
OR3 Ord. Physics	Harvard	Dr. T. V. Hunt
OR3 Ord. Physics	Pennsylvania	Dr. J. G. Brainerd
OT2,OT3 Ord. Mech-El Prop.	M. I. T.	Pro. J. C. Hunsaker
OW2, OW3 Ord. Sound	U. C. L. A.	Dr. V. O. Knudson

GROUP	UNIVERSITY	IN CHARGE
OX2, OX3 Ord. Sp. Physics	M. I. T.	Dr. N. H. Frank
RZ2 Atomic Energy Eng.	Univ. of Calif.	Capt. H. W. Need
ZG Civil Eng.	Rensselaer Poly. I.	Capt. M. T. Farrar
ZH Law	Georgetown Univ.	Office of J A G
ZH Law	George Washington U.	" " "
ZH Law	Catholic Univ.	" " "
ZK Bus. Admin	Harvard Univ.	Capt. C. J. Bonney
ZM Textile Eng.	Lowell Institute	- - - - - - -
ZP Personnel Man. & Tr.	Ohio State	Capt. J. D. Shaw
ZP " " "	Stanford Univ.	Capt. C. E. Crombe
ZP " " "	Northwestern Univ.	Capt. J. F. Newman

ORGANIZATION



PART II

CURRICULUMS FOR STUDENT OFFICERS COMMENCING POSTGRADUATE INSTRUCTION AT THE POSTGRADUATE SCHOOL, ANNAPOLIS

AEROLOGICAL ENGINEERING CURRICULUM
M - groups

Objective

To prepare officers:
(a) To become competent aerological officers,
(b) To improve the methods of forecasting weather,
(c) To investigate and participate in the solution of any problems involving atmospheric conditions such as (1) visibility (2) turbulence (3) aircraft icing (4) ballistic winds and densities (5) micro-meteorology, etc.

First Year - M

Summer Term

Ma-101	Ord. Differential Equations	5-0
Mr-211	Weather Maps and Codes	2-9
Ph-196	General Physics	5-1
La-101 201	German or Russian	2-0
		14-10

Fall Term

Ma-102	Series & Vector Algebra	5-0
Mr-212	Surface Weather Map Analysis	1-12
Mr-210	Introduction to Synoptic Meteorology	5-0
La-102 202	German or Russian	2-0
		13-12

Winter Term

Ma-103	Funct. of Sev. Var. & Vect. Anal.	5-0
Mr-213	Surface Weather Map Analysis	0-9
Mr-411	Thermodynamics of Meteorology	5-2
Mr-510	Climatology	2-0
La-103 203	German or Russian	2-0
SL-101	New Weapons Development	0-1
		14-12

Spring Term

Ma-134	Selected Topics for Fluid Mechanics	4-0
Mr-214	Weather Analysis and Forecasting	2-9
Mr-321	Dynamic Meteorology I	3-0
Mr-412	Physical Meteorology	3-0
La-104 204	German or Russian	2-0
SL-102	New Weapons Development	0-1
		14-10

Intersessional Field Trip

Second Year - M 2

Summer Term

Ma-135	Partial Differential Equations & Introduction to Statistics	4-0
Mr-221	Weather Analysis and Forecasting	1-9
Mr-228	Southern Hemisphere and Tropical Meteorology	2-0
Mr-322	Dynamic Meteorology II	3-0
La-105 205	German or Russian	2-0
		12-9

Fall Term

Ma-331	Statistics	4-2
Mr-222	Weather Analysis & Forecasting	0-12
Mr-229	Selected Topics in Applied Meteorology	2-0
Mr-323	Dynamic Meteorology III (Turbulence & Diffusion)	3-0
La-106 206	German or Russian	2-0
		11-14

Winter Term

Mr-223	Advanced Weather Analysis and Forecasting	0-9
Mr-110	Radiological Defense	2-0
Mr-410	Meteorological Instruments	2-2
Mr-422	The Upper Atmosphere	4-1
*Mr-921	Thesis	2-0
La-107 207	German or Russian	2-0
SL-101	New Weapons Development	0-1
		10/12-13

Spring Term

Mr-224	Advanced Weather Analysis and Forecasting	0-15
Mr-225	Upper Air Analysis	0-10
Mr-420	Wave and Swell Forecasting	2-1
#Mr-810	Seminar	2-0
*Mr-922	Thesis	4-0
La-108 208	German or Russian	2-0
SL-102	New Weapons Development	0-1
		8/10-27

*Taken only by candidates for the master's degree.
#Omitted by candidates for the master's degree.

APPLIED AEROLOGY CURRICULUM
MA-groups

Objective

To prepare officers to become competent aerological officers.

One Year - MA

Summer Term

Ma-161	Algebra and Analytic Geometry	5-0
Mr-201	Weather Maps and Codes	2-12
Mr-200	Introduction to Synoptic Meteorology	3-0
Ph-190	Introduction to Physics	3-0
	Total	13-12

Fall Term

Ma-162	Differential and Integral Calculus	5-0
Mr-202	Surface Weather Map Analysis and Forecasting	2-12
Mr-301	Synoptic Meteorology	5-0
Mr-402	Meteorological Charts and Diagrams	3-0
	Total	15-12

Winter Term

Mr-203	Weather Analysis and Forecasting	2-12
Mr-302	Synoptic Meteorology	5-0
Mr-410	Meteorological Instruments	2-2
Mr-403	Physical Meteorology and Physical Oceanography	4-0
SL-101	New Weapons Development	0-1
	Total	13-15

Spring Term

Mr-110	Radiological Defense	2-0
Mr-204	Advanced Weather Analysis Forecasting	0-15
Mr-205	Upper Air Analysis	0-10
Mr-404	Wave, Swell and Surf Forecasting	0-2
SL-102	New Weapons Development	0-1
	Total	2-28

SPECIAL AEROLOGICAL ENGINEERING CURRICULUM
MS - Groups

Objective

To permit specially selected aerological officers who have previously completed a short war-time curriculum:

(a) To acquire the necessary theoretical and practical training for advanced work in the field of meteorology.

(b) To acquaint these officers with the latest developments in meteorology and special weapons.

(c) To give these officers an opportunity to qualify for a Master of Science Degree.

Curriculum begins in January

Winter Term

Ma-103	Funct. of Sev. Var. & Vect. Anal.	5-0
Mr-411	Thermodynamics of Meteorology	5-2
Mr-510	Climatology	2-0
SL-101	New Weapons Development	0-1
		12-3

Spring Term

Ma-134	Selected Topics for Fluid Mechanics	4-0
Mr-214	Weather Analysis & Forecasting	2-9
Mr-321	Dynamic Meteorology I	3-0
Mr-412	Physical Meteorology (optional)	3-0
SL-102	New Weapons Development	0-1
		12-10

Second Year

Summer Term

Ma-135	Partial Differential Equations & Introduction to Statistics	4-0
Mr-221	Weather Analysis & Forecasting	1-9
Mr-228	Southern Hemisphere & Tropical Meteorology	2-0
Mr-322	Dynamic Meteorology II	3-0
		10-9

Fall Term

Ma-331	Statistics	4-2
Mr-222	Weather Analysis & Forecasting	0-12
Mr-229	Selected Topics in Applied Meteorology	2-0
Mr-323	Dynamic Meteorology III (Turbulence and Diffusion)	3-0
		9-14

Winter Term

Mr-110	Radiological Defense	2-0
Mr-223	Advanced Weather Analysis and Forecasting	0-9
Mr-422	The Upper Atmosphere	4-1
Mr-921	Thesis	2-0
SL-101	New Weapons Development	0-1
		8-11

Spring Term

Mr-224	Advanced Weather Analysis and Forecasting	0-15
Mr-225	Upper Air Analysis	0-10
Mr-420	Wave and Swell Forecasting	2-1
Mr-922	Thesis	4-0
SL-102	New Weapons Developments	0-1
		6-27

AERONAUTICAL ENGINEERING CURRICULUM

For students entering July 1948- "A" Group-45 officers

FIRST YEAR

(1) Summer Term		(2) Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ae-100 Basic Aerodynamics	3-4
Mc-111 Statics & Kinematics	5-0	Ma-102 Series & Vector Algebra	5-0
Ch-121 Chemistry (Fuel & Oil)	4-2	Mc-112 Kinetics	3-0
Mt-201 Phys. Metallurgy-Introd.	3-2	ME-531 Strength of Materials	3-0
		ME-601 Materials Testing	0-2
	17-4	Mt-202 Phys. Metallurgy (Ferrous)	3-2
		Ae-001 Lecture - Aeronautics	0-1
			17-9

(3) Winter Term		(4) Spring Term	
Ae-121 Technical Aerodyn.	3-2	Ae-131 Aerodynamics - Performance	4-2
Ae-201 Aeron. Stress Analysis	4-2	Ae-202 Stress Analysis II	4-2
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	EE-231 AC Circuits & Machs.	3-2
EE-111 Electrodynamics	3-2	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
Mt-203 Physical Metallurgy	2-2	Ma-201 Graph. & Mech. Computation	0-2
SL-101 Lecture - New Weapon Dev.	0-1	SL-102 Lecture - New Weapon Dev.	0-1
	17-9		16-9

Intersessional period - Six weeks in the field at aeronautical activities.

SECOND YEAR

Same as for Aeornautical Engineering Group entering July 1947.

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AERONAUTICAL ENGINEERING CURRICULUM - SECOND YEAR

"A2"

(5) Summer Term

Ae-203	Stress Analysis III	4-0
Ae-311	Airplane Design I	2-4
Ae-501	Theoret. Aerodynamics I	4-0
ME-131	Chem. Eng'y. Thermo.	4-2
EE-731	Power Electronics	3-2
		17-8

(6) Fall Term

Ae-132	Flight Analysis	3-2
Ae-204	Stress Analysis IV	4-0
Ae-312	Airplane Design II	2-4
Ae-502	Theoret. Aerodynamics II	4-0
ME-132	Chem. Eng'y. Thermo.	3-2
Ae-001	Lecture - Aeronautics	0-1
		16-9

(7) Winter Term

Ae-503	Theoret. Aerodynamics III	4-0
Ae-141	Aircraft Dynamics I	3-4
Ae-321	Adv'cd Airc. Structures	4-0
Ae-411	Internal Comb. Engines	3-2
Ch-521	Chemistry - Plastics	3-2
SL-101	Lecture - New Weapon Dev.	0-1
		17-9

(8) Spring Term (Structures Group)

Ae-142	Airc. Dynamics II	3-4
Ae-421	Airc. Propulsion	3-2
Mc-311	Vibrations	3-2
ME-632	Exper. Stress Analysis	2-2
Ae-431	Gas Turbines	4-0
SL-102	Lecture - New Weapon Dev.	0-1
		15-11

(8) Spring Term (Compressibility & Propulsion Group)

Ae-142	Airc. Dynamics II	3-4
Ae-421	Airc. Propulsion	3-2
Mc-311	Vibrations	3-2
Ae-431	Gas Turbines	4-0
Ch-571	Physical Chemistry	3-2
SL-102	Lecture - New Weapon Dev.	0-1
		16-11

Third year Aeronautical Engineering will be conducted at a civilian institution.

AERONAUTICAL ENGINEERING (ARMAMENT) CURRICULUM

FIRST YEAR COMMENCING JULY 1948-AT POSTGRADUATE SCHOOL

(1) Summer Term

EE-151	DC Circuits & Fields	3-4
Ma-101	Ord. Diff. Equations	5-0
Mc-111	Statics & Kinematics	5-0
Ch-101	Elements of Phys. Chem.	3-2
		16-6

(2) Fall Term

EE-251	AC Circuits	3-4
Ma-102	Series & Vector Algebra	5-0
Mc-112	Kinematics	3-0
ME-531	Strength of Materials	3-0
Ae-100	Basic Aerodynamics	3-4
Ae-001	Lecture - Aeronautics	0-1
		17-9

(3) Winter Term

EE-451	AC Mach. Transfrms & Synch.	2-2
Ma-103	Funct. of Sev. Var. & Vect. Anal.	5-0
Mt-201	Elements of Metallurgy	3-2
Ae-201	Aero. Stress & Struct. Anal.	4-2
Ae-121	Technical Aerodynamics	3-2
SL-101	Lecture - New Weapon Dev.	0-1
		17-9

(4) Spring Term

EE-452	AC Mach. Transfrmrs-Syn	2-2
Ma-104	Part. Diff. Eq. & Rel. Topics	5-0
Mt-202	Metallurgy - Ferrous	3-2
Ae-202	Aeron. Stress Analysis II	4-2
Ae-136	Aerodynamics - Performance	3-2
SL-102	Lecture - New Weapon Dev.	0-1
		17-9

Intersessional period - Six weeks in the field at Aviation armament activities.

SECOND YEAR

(5) Summer Term

EE-551	Transmsn Lines & Filters	3-2
Ma-155	Selected Adv. Topics	3-0
EE-751	Electronics - Vac. Tubes	3-4
Ae-311	Aircraft Design	2-4
Ae-501	Theoretical Aerodynamics	4-0
		15-10

(6) Fall Term

EE-755	Vacuum Tubes & Circts	3-4
Mc-401	Exterior Ballistics	4-0
Ma-401	Math. Comp. by Mech. Means	2-0
Ma-106	Comp. Var. & LaPlace Ty.	4-0
Ae-502	Theoret. Aerodynamics II	4-0
IE-101	Lecture - Indust. Engrg.	0-1
Ae-001	Lecture - Aeronautics	0-1
		17-6

(7) Winter Term

EE-671	Transients	3-4
Mc-402	Dynamics of a Rigid Body	3-0
Or-404	G.M. Guidance	2-0
Ch-521	Chemistry - Plastics	3-2
Ae-146	Aircraft Dynamics	3-2
SL-101	Lecture - New Weapon Dev.	0-1
IE-103	Lecture - Indust. Engineer.	0-1
		14-10

(8)Spring Term

EE-753	Electronics - Gas Tubes	1-2
EE-672	Servo Mechanisms	3-4
Es-441	Introd. to Radar	2-2
Mt-203	Metallurgy - Light alloy	2-2
Mc-201	Topics in Adv. Dynamics	2-2
Or-405	G.M. Guidance	1-0
SL-102	Lecture - New Weapon Dev.	0-1
		11-12

Third year at Massachusetts Institute of Technology

AERONAUTICAL ENGINEERING (ARMAMENT) CURRICULUM

"AR2"

(5) Summer Term		(6) Fall Term	
EE-351 D.C. Machinery	2-2	EE-452 A.C. Machines	3-4
EE-451 Transformers & Synchros	2-2	Ma-106 Complex Var. & LaPlace Tr.	4-0
Ma-155 Selected Adv. Topics	3-0	Mc-401 Exterior Ballistics	3-0
Ma-401 Math. Comp. by Mech.Means	2-0	Or-405 G.M. Guidance	1-0
Or-404 G.M. Guidance	2-0	Ae-132 Flight analysis	3-2
Ae-311 Aircraft Design	2-4	Ae-001 Lecture-Aeronautical	0-1
Ae-203 Stress Analysis III	4-0		
	17-8		14-7

(7) Winter Term		(8) Spring Term	
EE-551 Transm'n Lines & Filtrs	3-2	EE-651 Transients & Servos	3-4
Es-261 Electron Tubes	3-2	Es-262 Electron Tubes	3-2
Mc-402 Dynamics of a Rigid Body	3-0	Mc-201 Topics in Adv. Dynamics	2-2
Ae-141 Aircraft Dynamics I	3-4	Ae-142 Aircraft Dynamics II	3-4
IE-103 Lecture-Indust. Engrg.	0-1	SL-102 Lecture-New Weapon Dev.	0-1
SL-101 Lecture-New Weapon Devel.	0-1		11-13
	12-10		

APPLIED COMMUNICATIONS CURRICULUM C-9

OBJECTIVE

To prepare selected officers of the Navy:

(a) By a thorough operational knowledge of communications, to assist the Naval Communication Service in its functions as in indispensible accessory of Command.

(b) to be competent tactical officers, and to better perform duties of the Line.

(c) To be competent supervisors over the service operation of all types of apparatus utilized by the Naval Communication Service.

(d) To perform various administrative duties of the Naval Communication Service.

Summer Term		Fall Term	
Co-101 Typing & Radio Code	0-4	Co-102 Radio Code & Procedure	0-4
Co-110 Communication Security	1-1	Co-111 Teletype, Append. to Comm. Inst.	2-1
Co-120 Basic Nav Comm. Instruc.	2-3	Co-121 Basic Rapid Comm. Plan	2-2
Co-202 Tactics	2-2	Co-203 Tactics	2-2
Co-120 Corr. Course in Strategy & Tactics	-	Co-210 Corr. Course in Strategy & Tactics	-
Es-186 Fund. of Radio Comm.	4-4	Es-283 Vacuum Tube Circuits	4-4
Es-281 Electronics Fund.	2-2	Es-786 R.F. Energy Trans.	4-2
	11-16		14-15

Winter Term		Spring Term	
Co-103 Visual & Voice Proc.	0-3	Co-104 Comm & Other Nav Organ.	2-1
Co-112 Intern. & Comm. Comm.	1-1	Co-113 Correspondence & Mail	1-0
Co-122 Basic Rapid Comm. Plans; Type & Task Force Comm. Plan	2-3	Co-114 Crypto Systems Instruc.	0-2
Co-204 Tactics	2-2	Co-123 Amphibious Comm. Plan.	1-3
Co-210 Corr Course in Strategy & Tactics	-	Co-205 Tactics	2-2
Es-283 Vacuum Tube Circuits	4-4	Co-210 Corr. Course in Strategy & Tactics	-
Es-286 Pulsing & H.F. Circuits	2-2	Es-386 Trans. & Receivers	3-3
SL-101 New Weapon Develop.	**0-1	Es-586 Special Systems	3-3
	11-16	SL-101 New Weapon Develop.	**0-1
			12-15

** Lecture course.

ELECTRICAL ENGINEERING (AERONAUTICAL) CURRICULUM

"EA"

FIRST YEAR COMMENCING JULY 1948

(1) Summer Term		(2) Fall Term	
Ma-101 Ord. Diff. Equations	5-0	EE-271 Elect. AC Circ & Theory	3-2
EE-171 Elect. Circuits & Flds	3-4	Ma-102 Series & Vector Algebra	5-0
Mc-111 Statics & Kinematics	5-0	Mc-112 Kinetics	3-0
Ch-101 Elements Phys. Chemist	3-2	ME-531 Strength of Materials	3-0
	16-6	Ae-100 Basic Aerodynamics	3-4
		Ae-001 Lecture-Aeronautics	0-1
			17-7

(3) Winter Term		(4) Spring Term	
EE-272 Electr.-AC Circuits	2-2	EE-371 Elect. DC Machinery	3-2
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
Mt-201 Elements of Metallurgy	3-2	Ae-202 Aeron. Stress Analy. II	4-2
Ae-201 Aeron. Stress & Struct.	4-2	Ae-136 Aerodynamics-Performance	3-2
Ae-121 Technical Aerodynamic.	3-2	Mt-202 Metallurgy-Ferrous Mets	3-2
SL-101 Lecture-New Weap. Dev.	0-1	SL-102 Lecture-New Weap. Dev.	0-1
	17-9		18-9

Intersessional period. Six weeks in the field at aeronautical activities.

SECOND YEAR

(5) Summer Term		(6) Fall Term	
EE-471 Elect. AC Machines	3-4	EE-472 Elect. AC Machines	3-4
Ma-155 Selected Adv. Topics	3-0	Es-441 Introd. to Radar	2-2
Ae-311 Aircraft Design	2-4	EE-971 Electrical Seminar	1-0
Ae-203 Aeron. Stress Analys III	4-0	Ma-106 Comp. Var. & La Place Tr.	4-0
Ae-501 Theoretical Aerodynamc	4-0	Ma-201 Graph. & Mech. Comp.	0-2
	16-8	Ae-502 Theoret. Aerodynam. II	4-0
		IE-101 Lecture-Indust Enginrg	0-1
		Ae-001 Lecture-Aeronautics	0-1
			14-10

(7) Winter Term		(8) Spring Term	
EE-571 Transmsn Lines & Filtrs	3-4	EE-671 Elect.-Transients	3-4
EE-771 Power Electronics	3-2	EE-971 Electrical Seminar	1-0
EE-971 Electrical Seminar	1-0	EE-772 Power Electronics	2-2
Ch-521 Chemistry-Plastics	3-2	Mt-203 Metallurgy-Light Alloy	2-2
Ae-146 Aircraft Dynamics	3-2	Mc-201 Topics in Adv. Dynamics	2-2
SL-101 Lecture-New Weap. Devel.	0-1	ME-632 Exp. Stress Analysis	2-2
IE-103 Lecture-Indust. Enginrg	0-1	SL-102 Lecture-New Weap. Dev.	0-1
	13-12		12-13

Intersessional Period. Six weeks at aviation electronics laboratory.

Electrical Engineering (Aeronautical) "EA"

THIRD YEAR

(9) Summer Term

EE-672 Servo Mechanisms	3-4
EE-871 Theory of Elect.Mach design	4-0
EE (Ae) Aircraft Electrical Equipmt	3-2
Es-431 Radar Systems	3-3
Thesis	0-2
	13-11

(10) Fall Term

EE-872 Theory Elect Machine Design	4-0
EE-971 Electrical Seminar	1-0
EE (Ae) Airc. Elect. Equipment	2-2
Es-432 Radar Systems	3-6
Thesis	0-6
	10-14

(11) Winter Term

EE-873 Theory Elect. Mach. Design	4-0
EE-971 Electrical Seminar	1-0
EE(Ae) Airc. Elect. Equipment	3-2
Thesis	0-8
	8-10

(12) Spring Term

Es-536 Radio & Radar Counter-measures	2-3
EE-971 Electrical Seminar	1-0
EE(Ae) Airc. Elect. Equipment	3-2
Thesis	0-10
	6-15

ELECTRICAL ENGINEERING (AERONAUTICAL) CURRICULUM

"EA2"

SECOND YEAR

(5) Summer Term		(6) Fall Term	
EE-491 A.C. Machines	3-4	EE-492 A.C. Mach. & Trans. Lines	3-4
Ma-105 Fourier Ser. & Boundry Valve Prod.	4-0	EE-271 A.C. Theory	3-2
Ae-311 Airplane Design	2-4	Ma-106 Complex Var. & LaPlace Tr.	4-0
Ae-501 Theoretical Aerodyn	4-0	Ae-132 Flight Analysis	3-2
	13-8	Ae-312 Airplane Design II	2-2
		Ae-001 Lecture- Aeronautics	0-1
		IE-101 Lecture- Indust. Engrg.	0-1
			15-12

(7) Winter Term		(8) Spring Term	
EE-272 A.C. Theory	3-2	EE-872 Mach. Design	4-0
EE-591 Transm. Lines & Fil.	3-2	EE-791 Electronics & Synchros	3-2
EE-871 Elect. Mach. Desgn	4-0	EE-971 Elect. Seminar	1-0
Ch-521 Chemistry of Plast	3-2	Mc-311 Vibrations	3-2
Ae-141 Airc. Dynamics	3-4	Mc-201 Topics in Adv. Dynamics	2-2
	16-10	Ae-142 Aircraft Dynamics	3-4
			16-10

Intersessional period. Six weeks at an electronics laboratory.

THIRD YEAR

(9) Summer Term		(10) Fall Term	
EE-873 Elect. Mach. Des.	4-0	EE-971 Elect. Seminar	1-0
EE-792 Electronics	3-2	EE(Ae) Aircr. Elect. Instrum	3-2
Es-441 Introd to Radar	3-2	Ch-551 Chemistry	3-0
Ae-501 Theoret. Aerodyn	4-0	Ae-502 Theoretical Aerod. II	4-0
EE-972 Thesis	0-4	EE-972 Thesis	0-8
	14-8		11-10

(11) Winter Term		(12) Spring Term	
EE-971 Elect. Seminar	1-0	EE-971 Elect. Seminar	1-0
EE(Ae) Airc. Elect Pwr	3-2	EE(Ae) Airc. Elect. Power	2-2
EE(Ae) Airc. Elect. Inst.	2-0	EE Electricity (Special)	3-2
EE-972 Thesis	0-8	EE-972 Thesis	0-10
	6-10		6-14

Completion date June 1950

ELECTRONICS ENGINEERING

OBJECTIVE

To give the student a thorough practical and theoretical training in electronics engineering in preparation for future duties involving the development and use of electronics equipment and systems in the Naval Establishment.

FIRST YEAR (E1)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series and Vector Algebra	5-0
Es-111 Electricity	4-4	Es-112 Electricity	4-3
Es-211 Electron Tubes	2-3	Es-212 Electron Tubes	2-3
Ph-211 Optics	3-0	Ph-212 Phys. Optics & Dynamics	3-3
	14-7	IE-101 Industrial Engineering	0-1
			14-10

Winter Term		Spring Term	
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
Es-113 Circuit Analysis & Meas.	3-3	Es-114 Circuit Analysis & Meas.	3-3
Es-213 Electron Tubes	4-3	Es-214 Electron Tubes	4-3
Ph-113 Dynamics and Heat	3-0	Ph-311 Electrostatics & Magnetostatics	3-0
SL-101 New Weapons	0-1	SL-102 New Weapons	0-1
IE-103 Industrial Engineering	0-1	IE-104 Human Engineering	0-1
	15-8		15-8

SECOND YEAR (E2)

Summer Term		Fall Term	
Es-621 Electromagnetics	3-0	Es-622 Electromagnetics	4-0
EE-314 A.C. & D.C. Machines	3-4	EE-672 Servomechanisms	3-4
*Ph-421 Fundamental Acoustics	3-0	*Ph-422 Applied Acoustics	3-0
Es-225 Electron Tubes	3-6	Es-126 Radio Freq. Measurements	2-6
	12-10		12-10

Winter Term		Spring Term	
Es-623 Electromagnetics	4-0	Es-624 Electromagnetics	3-0
Es-121 Adv. Circuit Analysis	3-2	Es-122 Adv. Circuit Analysis	3-2
*Ph-423 Underwater Acoustics	2-3	Es-226 U.H.F. Tubes	4-3
Es-321 Radio Systems	3-3	Es-322 Radio Systems	3-3
	12-8		13-8

*Aviator members of group take:

Ph-410	Sound	3-0	(Summer term)
Ae-100	Basic Aerodynamics	3-4	(Fall term)
Ae-121	Technical Aerodynamics	3-2	(Winter term)

THIRD YEAR (E3)

Summer Term

Es-736 Antennas	3-3
Es-133 Adv. Circuit Analysis	3-0
Es-431 Radar Systems	3-3
Es-333 Radio Systems	2-3
	11-9

Fall Term

Es-531 Special Systems-	3-3
Es-134 Adv. Circuit Analysis	3-0
Es-432 Radar Systems	3-6
Es-831 Thesis Seminar	2-0
	11-9

Winter Term

This term is spent in an industrial plat or electronics laboratory, such as Bell Telephone Co., R.C.A., or General Electric Co. During this period the student works as a junior engineer or physicist on a selected project which forms part of, or is related to, his thesis.

Spring Term

Es-532 Special Systems	3-3
Es-036 Electronics Admin.	2-0
Es-832 Thesis Seminar	4-0
Es-836 Project Seminar	1-0
Ph-631 Modern Physics	4-0
	14-3

NAVAL ENGINEERING CURRICULUM - N groups
For N groups starting in 1946 and 1947 only

Objective

The objective of this curriculum is to develop officers competent to direct the inspection, installation and maintenance of naval machinery and equipment (excepting radio and underwater sound equipment) over which the Bureau of Ships has cognizance or for which the engineer officer afloat is held responsible by U.S. Navy Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineer officers of all types of naval vessels, and staff engineers afloat.

(b) Assignment to the operation and maintenance divisions of the Bureau of Ships.

(c) Assignment to navy yards, repair ships, and repair bases in connection with production, or maintenance and repair.

(d) Assignment to test and research activities such as the Naval Boiler Laboratory, Engineering Experiment Station, Naval Research Laboratory, and Material Test Laboratory.

(e) Inspectors of naval machinery and material.

Second year (N2)

Summer Term

EE-491	AC machines	3-4
ME-511	Str. of Materials	5-0
ME-411	Hydraulic Equip.	4-2
Ma-301	Statistics	3-2
	Total	15-8

Fall Term

ME-412	Fluid Mechanics	4-2
EE-492	AC Mach. & Long Lines	3-4
ME-111	Thermodynamics	4-2
ME-522	Str. of Materials	3-0
ME-611	Mat. Test & St. Anal.	1-2
	Total	15-10

Winter Term

Mt-203	Phy. Metallurgy	2-2
EE-591	Long Lines, Nets & Transients	3-2
EE-871	Elect. Eng. Design	2-0
ME-112	Thermodynamics	4-2
ME-310	Heat Transfer	3-2
	Total	14-8

Spring Term

Mt-301	High Temp. Materials	2-2
EE-791	Power Elec. & Synchros	3-2
EE-872	Elect. Eng. Design	3-0
ME-211	Mar. Power Plant Equip.	3-2
ME-700	Mech. of Mach.	3-2
	Total	14-8

Intersessional Field Trip

Third year (N3)

Summer Term

EE-792	Power Electronics	3-2
EE-873	Elect. Eng. Design	3-0
ME-212	Marine Power Pt. Equip	3-4
ME-213	Mar. Power Pt. (ICE)	3-2
ME-811	Mach. Design	3-2
	Total	15-10

Fall Term

ME-215	Power Pt. Analysis	2-4
ME-214	Mar. Power Pt. (ICE)	3-2
ME-812	Mach. Design	3-4
EE-672	Automatic controls	3-4
	Total	11-14

Winter Term

Ch-521	Plastics	3-2
ME-216	Mar. Power Pt. Anal.	2-4
NE-101	Marine Eng. (Prop)	3-0
Es-991	Introd. Elect.	2-0
	Thesis	0-12
	Total	10-18

Spring Term

NE-102	Marine Eng. (Aux.)	3-0
NE-103	Mar. Eng. Dept. Org.	1-0
Es-992	Electronics	2-0
	Thesis	0-24
	Total	6-24

NAVAL ENGINEERING CURRICULUM
Applied - NA groups

Objective

The general objective of this curriculum is to develop officers competent to:

(a) Direct the inspection, installation, operation and maintenance of naval machinery and equipment (excepting radio and sound equipment) over which the Bureau of Ships has cognizance, or for which the Engineering Officer afloat is held responsible by the U.S. Navy Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineering officers of all types of naval vessels and staff engineers afloat.
(b) Maintenance and Repair assignments in the Bureau of Ships, on repair ships, at navy yards, and repair bases.
(c) Inspectors of Naval Machinery and Material.

First Year (NA)

Summer Term

Ma 171	Ord. Diff. Equations	3-0
Ma 201	Graph. & Mech. Comp.	0-2
Mc 141	Statics, Kinematics & Kinetics	4-0
Ch 101	Gen. Chemistry	3-2
EE 151	DC Circuits & Fields	3-4
	Total	13-8

Fall Term

Ma 172	Diff. Eq. & Infinite Series	3-0
Mc 142	Dynamics & Special Topics	3-0
GL 101	Navigation	2-2
Or 304	A. A. Fire Control	1-2
EE 251	AC Circuits	3-4
	Total	12-8

Winter Term

Ma 173	Part. Diff. Eq. & Vector Algebra	3-0
GL 102	Navigation	2-2
Or 205	Surface Fire Control	2-0
Ch 111	Fuel & Oil Chemistry	2-2
Ph 610	Atomic physics	3-0
EE 351	DC Machinery	2-2
	Total	14-6

Spring Term

Ma 174	Vect. Anal. & Funct. of a Complete Var.	3-0
Ph 210	Geom. & Phy. optics	3-2
Mt 201	Phy. Metallurgy	3-2
EE 451	AC Mach. Transf. & Synchros	2-2
ME 111	Thermodynamics	4-2
	Total	15-8

Intersessional Field Trip

Second Year (NA2)

Summer Term

EE 452 AC Machinery	3-4
ME 122 Thermodynamics	4-2
ME 500 Str. of Materials	3-0
ME 601 Materials Testing Lab.	0-2
Mt 202 Phy. Metallurgy	3-2
Total	13-10

Fall Term

EE 751 Electronics	3-4
ME 213 Int. Comb. Eng.	3-2
ME 420 Hydraulic Equip.	4-4
*IE 101 Industrial Eng.	0-1
Mr 100 Meteorology	2-0
Total	12-11

Winter Term

ME 214 Int. Comb. Eng.	3-2
Mt 203 Phy. Metallurgy	2-2
ME 221 Power Plant Equip	4-4
NE 101 Mar. Eng. (Main prop.)	3-0
*IE 103 Industrial Eng.	0-1
*SL 101 New Weapons	0-1
	12-10

Spring Term

EE 651 Transients & Servos	3-4
ME 700 Mechanics of mach.	3-2
ME 222 Power Plant Analysis	0-6
NE 102 Mar. Eng. (Aux. Mach)	3-0
NE 103 Mar. Eng. (Dept. Org.)	1-0
*IE 104 Human Eng.	0-1
*SL 102 New Weapons	10-14

*Lecture Course

NAVAL ENGINEERING
Chemical Curriculum - NC groups

Objective

The objective of this curriculum is to provide the training necessary for a selected group of officers to (a) supervise and direct activities at the Standards Branch, Bureau of Ships involving Chemical processes; (b) to act in an advisory capacity with civilian establishments in the development and production of materials for the naval service; (c) to be able to appreciate developments in industry involving materials other than metals, such as paints, protective coatings, plastics, etc., and advise the Bureau of Ships as to the suitability of such developments in solving problems of maintainance and repair.

First year (NC)

Summer Term

Ma-101	Ord. Diff. Equations	5-0
Ma-201	Graph & Mech. Comp	0-2
Mc-141	Statics, Kinematics & Kinetics	4-0
Ch-101	General Chemistry	3-2
EE-171	Elect. Circuits & Fields	3-4
	Total	15-8

Fall Term

Ma-102	Series & Vector Algebra	5-0
Mc-142	Dynamics & Special Topics	3-0
Ch-211	Analytical chemistry	3-2
Ch-521	Plastics (Eng. Materials)	3-2
Mt-201	Physical metallurgy	3-2
	Total	17-6

Winter Term

Ma-103	Funct. of Sev. Var. & Vect. Anal.	5-0
Ch-411	Physical Chemistry	2-2
Ch-611	Thermodynamics (chem)	3-2
Cr-241	Crystallography & X-ray	3-0
Me-601	Mat. Test & Str. Anal.	0-2
Me-500	Strength of Materials	3-0
*SL-101	New Weapons	0-1
	Total	16-7

Spring Term

Ch-701	Chemical Calculations	3-2
Ch-412	Physical Chemistry	2-2
Ch-612	Thermodynamics (chem)	3-2
Mt-202	Phys. Metal. (Ferrous)	3-2
Mt-203	Phys. Met. (Spec. Topics)	2-2
*SL-102	New Weapons	0-1
	Total	13-11

*Lecture Course Intersession at Field Trip

Second Year (NC2)
at Lehigh University

First Term		Second Term	
Chem. b			
Chem.150 Org. Chem. Lab.	3	Chem.151 Org. Chem. Lab.	3
Chem.165 Org. Chem. Lab.	2	Chem.167 Org. Chem. Lab.	2
Chem.190 Phys. Chem.	3	Chem.194 Phys. El. Chem.	3
Chem.192 Phys. Chem. Lab.	1	Chem.197 El. Chem. Lab.	1
Ch.E.78 Chem. Eng.	3	Ch.E. 79 Chem. Engr.	3
Credit hours	12	Ch.E. 180 Chem. Engr.	3
		Credit hours	15

Intersessional Field Trip

Third year (NC3)
at Lehigh University

First Term		Second Term	
Ch.E-181 Chem. Eng.	3	Ch.E. 283 Chem. Engr.	3
Ch.E-282 Chem. Eng.	3	Ch.E. 281 Chem. Engr. Res.	4
Ch.E-183 Unit Proc.	3	Ch.E. 185 Chem. Engr. Prac.	1
Ch.E-280 Chem. Engr. Res.	4	Chem.297 Surface Chem.	3
Chem. 296 Surface Chem.	3	Chem.159 Adv. Org. Chem.	3
Credit hours	16	Credit hours	14

NAVAL ENGINEERING CURRICULLUM
Mechanical - NH groups

Objective

The object of this Curriculum is to develop officers competent to direct the inspection, installation, and maintenance of Naval Machinery and equipment (excepting radio and underwater sound equipment) over which the Bureau of Ships has cognizance or for which the engineer officer afloat is held responsible by U.S. Naval Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineer officers of all types of naval vessels, and staff engineers afloat.

(b) Assignment to the operation and maintenance divisions of the Bureau of Ships.

(c) Assignment to navy yards, repair ships, and repair bases in connection with production, or maintenance and repair.

(d) Assignment to test and research activities such as the Naval Boiler Laboratory, Engineering Experiment Station, Naval Research Laboratory, and Material Test Laboratory.

(e) Inspectors of Naval Machinery and Material.

First Year (NH)

Summer Term

Ma 101	Ord. Diff. Equations	5-0
Ma 201	Graph. & Mech. Comp.	0-2
Ch 101	Gen. Chemistry	3-2
Mc 141	Statics, Kinematics & Kinetics	4-0
EE 171	Elect. Cir. & Fields	3-4
		15-8

Fall Term

Ma 102	Series & Vector Algebra	5-0
Ph 610	Atomic Physics	3-0
Ch 111	Fuel & Oil Chem.	2-2
Mc 142	Dynamics & Special Topics	3-0
EE 251	A.C. Circuits	3-4
		16-6

Winter Term

Ma 103	Funct. of Sev. Var. Vect. Anal.	5-0
Ph 410	Wave Motion & Acoustics	3-0
Ch 561	Physical Chem.	3-2
Mc 201	Topics in Adv. Dynamics	2-2
EE 351	DC Machinery	2-2
		15-6

Spring Term

Ma 104	Part. Diff. Eq. & Rel. Topics	5-0
ME 710	Theory of Vibrations	3-2
EE 451	AC Machinery	2-2
ME 111	Thermodynamics	4-2
		14-6

Intersessional Field Trip

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Second Year (NH2)

Summer Term

Ph 210 Geom. & Phys. Optics	3-2
Mt 201 Phy. Metallurgy	3-2
ME 112 Thermodynamics	4-2
EE 452 AC Mach. Trans.	3-4
	13-10

Fall Term

ME 411 Hydraulic Equip.	4-2
Mt 202 Phy. Metal.	3-2
ME 511 Str. of Materials	5-0
Ch 613 Chem. Eng. Thermo.	3-2
*IE 101 Ind. Organization	0-1
	15-7

Winter Term

Mt 203 Phy. Metallurgy	2-2
EE 751 Electronics	3-4
ME 412 Hydrodynamics	4-2
ME 512 Adv. Str. of Materials	5-0
*IE 103 Ind. Org.	0-1
*SL 101 New Weapons	0-1
	14-10

Spring Term

ME 700 Mech. of Mach.	3-2
ME 211 Mar. PP Equip.	3-2
ME 413 Mech. of Elastic Fluids	3-0
ME 611 Materials Testing	2-2
ME 310 Heat Transfer	3-2
*IE 104 Human Engineering	0-1
*SL 102 New Weapons	0-1
	14-10

*Lecture Course
Intersessional Field Trips

Third Year (NH3)

Summer Term

ME 212 Mar. Power Plant Equip.	3-4
ME 632 Exp. Stress Analysis	3-2
ME 811 Machine Design	3-2
ME 590 Theory of Elasticity	3-0
Mt 301 High Temp. Metallurgy	2-2
	14-10

Fall Term

ME 215 Mar. PP Analysis	2-4
NE 101 Naval Eng. Main Prop.	3-0
ME 812 Adv. Mach. Design	3-4
ME 217 Int. Comb. Eng.	4-4
	12-12

Winter Term

ME 216 Mar. PP Anal.	2-4
EE 651 Transients & Servos	3-4
Thesis	9-0
	14-8

Spring Term

NE 102 Nav. Eng. Auxiliaries	3-0
NE 103 Eng. Dep. & Org.	1-0
Thesis	14-0
	18-0

NAVAL ENGINEERING
Gas Turbine Curriculum - NJ groups

Objective

The objective of the curriculum is by means of practical and theoretical instruction to train a selected group of U. S. Navy officers to be capable of:

(a) Evaluating future trends in the field of Gas Turbine and Jet Propulsion and advising as to the limitations and capabilities of such means as applicable to propulsion requirements of naval vessels.

(b) Directing and supervising research and development in the field of Gas Turbine and Jet Propulsion as may be applicable to propulsion of naval vessels.

(c) Acting in an advisory capacity with civilian establishments in the development and production of such naval machinery as may in the future be operated by the use of Gas Turbines and Jet Propulsion.

First Year (NJ)

Summer Term

Ma 101 Ord. Diff. Eq.	5-0
Ma 201 Graph. & Mech. Comp.	0-2
Mc 141 Statics, Kinematics & Kinetics	4-0
Ch 101 Gen. Chemistry	3-2
EE 171 Elect. Cir. & Fields	3-4
	15-8

Fall Term

Ma 102 Series & Vector Algebra	5-0
Mc 142 Dynamics & Special Topics	3-0
ME 141 Chem. Eng'y. Thermo.	4-2
Ae 100 Basic Aerodynamics	3-4
	15-6

Winter Term

Ch 111 Fuel & Oil Chemistry	2-2
Ma 103 Funct. of Sev. Var. & Vector Anal.	5-0
Ch 411 Physical Chemistry	2-2
Mt 201 Physical Metallurgy	3-2
ME 142 Chem. Eng'y. Thermo.	2-2
	14-8

Spring Term

Ma 104 Part. Diff. Eq. & Rel. Topics	5-0
Ch 412 Physical Chemistry	2-2
Ph 540 Kinetic Theory of Gases	3-0
ME 143 Chem. Eng'y Thermo.	4-4
	14-6

Intersessional Field Trips

Second Year

Summer Term

Ma 155 Selected Adv. Topics	4-0
Mt 202 Physical Metallurgy	3-2
ME 500 Strength of Materials	3-0
ME 601 Mat. Testing Lab.	0-2
Ae 501 Theory of Aero.	4-0
	14-4

Fall Term

Ma 106 Complex Var. & LaPlace Tr.	4-0
EE 251 A.C. Circuits	3-4
Ch 613 Chem. Eng. Thermo.	3-2
IE 101 Ind. Organization	0-1
Ae 502 Theory of Aero.	4-0
	14-7

Winter Term

MT 203 Physical Metallurgy	2-2
EE 751 Electronics	3-4
EE 451 A.C. Mach. Transf. & Synchros	2-2
Ae 503 Supersonic Aerodynamics	3-2
Ae 451 Gas Turbine Seminar	3-0
IE 103 Ind. Engineering	0-1
SL 101 New Weapons	0-1
	13-12

Spring Term

EE 452 A.C. Machines	3-4
Mt 301 High Temp. Met.	3-0
Ae 431 Gas Turbines & Jets	3-2
Ae 452 Gas Turbine Seminar	3-0
IE 104 Ind. Engineering	0-1
SL 102 New Weapons	0-1
	12-8

NAVAL ENGINEERING CIRRICULUM
Electrical - NL groups

Objective

The objective of this curriculum is to develop officers competent to direct the inspection, installation, and maintenance of naval machinery and equipment (excepting radio and underwater sound equipment) over which the Bureau of Ships has cognizance or for which the engineer officer afloat is held responsible by the U. S. Navy Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineer officers of all types of naval vessels, and staff engineers afloat.

(b) Assignment to the operation and maintenance divisions of the Bureau of Ships.

(c) Assignment to navy yards, repair ships, and repair bases in connection with production, or maintenance and repair.

(d) Assignment to test and research activities such as the Naval Boiler Laboratory, Engineering Experiment Station, Naval Research Laboratory, and Material Test Laboratory.

(e) Inspectors of naval machinery and material.

First year (NL)

Summer Term

Ma-101	Ord. Diff. Equations	5-0
Ma-201	Graph & Mech. Comp.	0-2
EE-171	Elect. Cir. & Fields	3-4
Ch-101	Gen. Chem.	3-2
Mc-141	Statics, Kinematics & Kinetics	4-0
		15-8

Fall Term

Ma-102	Series & Vector Algebra	5-0
EE-271	A.C. Circuits	3-2
Ch-111	Fuel & Oil Chem.	2-2
Mc-142	Dynamics & Special Topics	3-0
Ph-610	Atomic Physics	3-0
		16-4

Winter Term

Ma-103	Funct. of Sev. Var. & Vect. Anal.	5-0
EE-272	A.C. Circuits	2-2
Mc-201	Topics in Adv. Dynamics	2-2
Ma-301	Statics	3-2
ME-500	Str. of Materials	3-0
ME-601	Str. of Materials (lab.)	0-2
		15-8

Spring Term

Ma-104	Part. Diff. Eq. & Rel. Topics	5-0
EE-371	D.C. Machinery	3-2
ME-111	Thermodynamics	4-2
Mt-201	Phy. Metallurgy	3-2
		15-6

Intersessional Field Trip

Second Year (NL2)

Summer Term

Ma-155	Selected Adv. Topics	4-0
EE-471	A.C. Machinery	3-4
ME-112	Thermodynamics	4-2
Mt-202	Phy. Metallurgy	3-2
		14-8

Fall Term

Ma-106	Complex Var. & LaPlace	4-0
EE-472	A.C. Machinery	3-4
EE-971	Seminar	1-0
Mt-203	Phy. Metallurgy	2-2
ME-211	Mar. PP Equipment	3-2
*IE-101	Ind. Org.	0-1
		13-9

Winter Term

Ph-361	Electromagnetic Waves	3-0
EE-571	Transmission Lines & Filters	3-4
EE-971	Seminar	1-0
EE-771	Electronics	3-2
ME-212a	Mar. PP Equipment	3-2
*IE-103	Ind. Org.	0-1
*SL-101	New Weapons	0-1
		13-10

Spring Term

Ph-362	Electromagnetic Waves	3-0
ME-411	Fluid Mech. (Gen.)	4-2
EE-772	Electronics	3-2
EE-971	Seminar	1-0
ME-310	Heat Transfer	3-2
*IE-104	Human Eng.	0-1
*SL-102	New Weapons	0-1
		14-8

*Lecture Course
Intersessional Field Trip

Third year (NL3)

Summer Term

MI-301	High Temp. Metal	2-2
EE-871	Elect. Mach. Design	4-0
EE-671	Transients	3-4
ME-215	Mar. PP. Analysis	2-4
		11-10

Fall Term

EE-872	Elect. Mach. Design	4-0
EE-971	Seminar	1-0
ME-217	I.C. Engines	4-4
EE-672	Servo Mechanisms	3-4
	Thesis	3-0
		15-8

Winter Term

EE-873	Elect. Mach. Design	4-0
EE-971	Seminar	1-0
NE-101	Mar. Eng. (Main Prop.)	3-0
	Thesis	9-0
		17-0

Spring Term

EE-971	Seminar	1-0
NE-102	Mar. Eng. (Aux. Mach.)	3-0
NE-103	Mar. Eng. Org.	1-0
	Thesis	12-0
		17-0

NAVAL ENGINEERING
Metallurgy Curriculum - NM groups

Objective

The objective of this curriculum is to provide the training necessary for a selected group of officers to be (a) capable of supervising and directing activities at the Standards Branch Bureau of Ships relating to metals and alloys; (b) to advise the Bureau of Ships of developments in metallurgy that may be of value in ship design, maintenance, and operation; (c) to be capable of directing and supervising research activities involving metals and alloys, and direct activities in Naval Establishments concerned with production, maintenance, and repair.

First year (NM)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Ma-201 Graph. & Mech. Comp.	0-2	Mc-142 Dynamics & Special Topics	3-0
Mc-141 Statics, Kinematics & Kinetics	4-0	Ch-111 Fuel & Oil Chemistry	2-2
Ch-101 General Chemistry	3-2	Mt-101 Production Metallurgy	2-0
EE-171 Elect. Circuits & Fields	3-4	Mt-201 Physical Metallurgy	3-2
Total	15-8	Total	15-4

Winter Term		Spring Term	
Ch-521 Plastics (Eng. Materials)	3-2	Mt-203 Phys. Mettalurgy (Spec. Topics)	2-2
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ch-531 Phys. Chem. of Metal	2-0
Ch-411 Physical Chemistry	2-2	Ch-412 Physical Chem.	2-2
Mt-202 Physical Metallurgy (ferrous)	3-2	Mt-204 Physical Metal (Spec. topics)	3-4
ME-601 Mat. Test & St. Anal.	0-2	Cr-271 Cry. & X-Ray	3-2
ME-500 Str. of Materials	3-0	*SL-102 New Weapons	0-1
*SL-101 New Weapons	0-1		12-11
	16-9		

*Lecture Course
Intersessional Field Trip

Second year (NM2)
at Carnegie Institute of Technology

First Term		Second Term	
GE-657a Alloy steels	2-0-6	GE-657b Alloy steels	2-0-6
E-631 Fer. Met.	4-0-8	GE-644b Adv. Phys. Met.	2-0-6
GE-644a Adv. Phys. Met.	2-0-6	E-652 Mech. Met.	3-0-3
GE-697 Ord Met.	2-0-6	GE-655b Met. Problems	0-0-2
E-661 Mod. Met. Proc.	0-2-0	E-662 Mod. Met. Practice	0-2-0
GE-663C Radiography	0-2-4	S-292 Stat. Qual. Cont.	3-0-6
S-291 Stat. Qual. Cont.	3-0-6	E-666 Seminar	1-0-0
E-665 Seminar	1-0-0		49 units
	54 units		

Intersessional Field Trip

Third year (NM3)
at Carnegie Institute of Technology

First Term		Second Term	
GE-667a Adv. Mech. Met.	2-0-6	GE-667b Adv. Mech. Met.	2-0-6
GE-697 Welding Mat.	2-4-6	E-660 Met. Engrg.	4-0-8
E-661 Mod. Met. Prac.	0-2-0	E-662 Mod. Met. Practice	0-2-0
GE-676a Theory of metals	2-0-6	GE-676b Theory of metals	2-0-6
GE-647a Grad. Seminar	1-0-0	GE-674b Grad. Seminar	0-0-0
E-647 Non-Fer. Metal.	3-3-6	GE-670 Light Alloys	2-0-6
GE-664c Adv. Phys. Met.	2-0-6	GE-664d Adv. Phys. Met.	2-0-6
	50 units		46 units

NAVAL ENGINEERING
Nuclear Science Curriculum - NN Groups

Objective

By means of practical and theoretical instructions to train a selected group of U. S. Navy Officers that they may become competent to:

(a) Evaluate developments in the science of Nuclear Physics and to advise the Bureau of Ships as to the limitations and applicability of such developments in ship propulsion, operation, and maintenance.

(b) To assist in the supervision of work, relative to the research and design of such machinery, under the cognizance of the Bureau of Ships, as may in the future be operated by the use of nuclear energy.

(c) Act in an advisory capacity with civilian establishments in development and production of such naval machinery, under the cognizance of the Bureau of Ships, as may in the future be operated by the use of nuclear energy.

First year (NN)

Summer Term

Ma-101	Ord. Diff. Equations	5-0
Ma-201	Graph. & Mech. Comp.	0-2
EE-171	Elect. Cir. & Fields	3-4
Mc-141	Static, Kinematics and Kinetics	4-0
Ch-101	Gen. Chemistry	3-2
		15-8

Fall Term

Ma-102	Series & Vector Algebra	5-0
EE-251	A.C. Circuits	3-4
Mc-142	Dynamics & Special Topics	3-0
Ch-111	Fuel & Oil Chemistry	2-2
		13-6

Winter Term

Ma-103	Funct. of Sev. Var. & Vect. Anal.	5-0
EE-451	A.C. Mach. Transf. & Synchros	2-2
Ph-610	Atomic Physics	3-0
Es-261	Electron Tubes	3-2
Ch-561	Physical Chem.	3-2
		16-6

Spring Term

Ma-104	Part. Diff. Eq. & Rel. Topics	5-0
EE-452	A.C. Mach. & Trans.	3-4
ME-111	Thermodynamics	4-2
Es-262	Electron Tubes	3-2
		15-8

Intersessional Field Trip

Second Year (NN2)

Summer Term

Mt-201 Phy. metallurgy	3-2
Es-263 Electron Tubes	3-2
ME-112 Thermodynamics	4-2
ME-500 Str. of Materials	3-0
ME-601 Mat. Test & Anal.	0-2
	13-8

Fall Term

Mt-202 Phy. Metallurgy	3-2
ME-420 Hydraulic Equip.	4-4
ME-213 Int. Comb. Eng.	3-2
Ch-613 Chem. Eng. Thermo.	3-2
IE-101 Ind. Organization	0-1
	13-11

Winter Term

ME-221 Power Plant Equip.	4-4
Ph-210 Geom. & Phys. Optics	3-2
Ch-521 Plastics	3-2
Ph-731 Physics Seminar	3-0
*IE-103 Ind. Organization	0-1
*SL-101 New Weapons	0-1
	13-10

Spring Term

Mt-301 High Temp. Met.	2-2
ME-222 Power Plant Anal.	0-6
ME-310 Heat Transfer	3-2
Ch-551 Radio Chemistry	3-0
Ph-732 Physics Seminar	3-0
*IE-104 Human Engineering	0-1
*SL-102 New Weapons	0-1
	11-12

*Lecture Course

Third Year (NN3)

Clinton Laboratories at Oak Ridge, Tenn.

NAVAL ENGINEERING
Petroleum Curriculum - NP groups

Objective

The objective of this curriculum is, by means of practical and theoretical instruction, to train certain officers of the U. S. Navy in the technology of petroleum production, refining, and utilization of by-products therefrom, in preparation for future duties involving the development, properties, uses and application of fuels and lubricants in the Naval Establishment.

First Year (NP)

Summer Term

Ma-101	Ord. Diff. Equations	5-0
Ma-201	Graph. & Mech. Comp.	0-2
Mc-141	Statics, Kinematics & Kinetics	4-0
Ch-101	General Chemistry	3-2
EE-171	Elect. Circuits & Fields	3-4
		15-8

Fall Term

Ma-102	Series & Vector Algebra	3-0
Ge-101	Phy. Geology	3-0
Ch-211	Analytical Chemistry	3-2
Cr-301	Cry. & Mineralogy	2-4
Mc-201	Physical Metallurgy	3-2
		16-8

Winter Term

Ma-103	Funct. of Sev. Var. & Vect. Anal.	5-0
Ch-111	Fuel & Oil Chem.	2-2
Ch-611	Chem. Thermo.	3-2
GE-302	Determin. Mineralogy	1-4
ME-601	Mat. Test. & Str. Anal.	0-2
ME-500	Str. of Materials	3-0
*SL-101	New Weapons	0-1
	Total	14-11

Spring Term

Ch-301	Org. Chemistry	3-2
Ch-421	Physical Chemistry	4-2
Mt-202	Phy. Metal. (Ferrous)	3-2
Ge-241	Petroleum geology	1-2
Ge-401	Petrology & Petrography	2-2
*SL-102	New Weapons	0-1
	Total	13-11

*Lecture Course.
Intersessional Field Trip.

Second Year (NP2)
at University of California at Berkeley

First Term

Chem. 8	Org. Chemistry	3
Chem. 9	Org. Chem (lab.)	3
M.E.-103	Fluid Mechanics	3
P.E.-121A	Oil-Field Develop.	3
P.E.-129	Prod. & Util. of Nat. Gas	2
	Total Units	14

Second Term

P.E. 121-B	Oil Field Exploitation	3
P.E. 125	Pet. Eng. Economics	3
P.E. 299	Thesis Research	2
Chem. 107	Type Reaction Synthesis	3
Math. 264	Quality Control	3
	Total Units	14

Intersessional Field Trip

Third Year (NP3)
at University of California at Berkeley

First Term		Second Term	
Chem. 109 Phy. Chemistry	3	Chem. 143 Chem. Technology	3
P.E. 209A Pet. Refining Tech.	2	P.E.-209B Pet. Refining Tech.	2
M.E. 120 Eng. Invest. & Econ.	3	M.E. 118 Indust. Power Plant Design	3
Phy. 124 Radioactivity & Nuclear Structure		P.E. 299 Thesis Research	4
P.E. 299 Thesis Research	2		12
Total Units	13		

ORDNANCE ENGINEERING

General Ordnance Curriculum- O groups

OBJECTIVE

The objective of the Ordnance Engineering (General) curriculum is to prepare officers for future duties as inspectors of ordnance material, to equip them to deal with problems of development and production in Bureau of Ordnance establishments, and to give them the basic technical education to become expert operators of ordnance equipment afloat.

FIRST YEAR (O)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series and Vector Algebra	5-0
Mc-151 Statics & Kinematics	3-0	Ma-251a Graph. & Mech. Comp.	0-2
EE-151 D.C. Circuits & Fields	3-4	EE-251 A.C. Circuits	3-4
Ch-101 General Chemistry	3-2	Mc-152 Kinetics	3-0
Or-205 Surface Fire Control	2-0	Ch-521 Plastics	3-2
	16-6	Ord304 A.A. Fire Control	1-2
			15-10

Winter Term		Spring Term	
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104 Part. Diff. Eq.& Rel. Topics	5-0
Ma-251b Graph. & Mech. Comp.	0-2	ME-700 Mechanics of Machinery	3-2
Mc-153 Further Gen. Laws & Dimen. Anal.	3-0	EE-452 A.C. Machines	3-4
EE-451 Transformers & Synchros	2-2	OR-501 Underwater Ordnance	2-0
ME-500 Strength of Materials	3-0	OR-103 Ord. Admin. & Special Eqp.	2-0
ME-601 Strength of Mat. Lab.	0-2	*SL-102 New Weapon Dev. Lect.	
Or-305 A.A. Fire Control	2-0	Total	15-6
*SL-101 New Weapon Dev. Lect.			
Total	15-6		

*Lecture Course.
Intermissional Field Trip.

SECOND YEAR (02)
at Postgraduate School

Summer Term		Fall Term	
Ma-155 Selected Adv. Topics	3-0	Mc-431 Strength of Guns	3-0
EE-551 Transmission lines and filters	3-2	ES-441 Radar	2-2
Ph-211 Heat & Geo. Optics	3-0	Ma-106 Complex Var. & LaPlace Tr.	4-0
EE-751 Vacum tubes & Circuits	3-4	Ph-212 Physical Optics	3-2
OR-404 Guided Missiles Guid.	2-0	OR-405 Guided Missiles Guidance	1-0
OR-503 Underwater Ordnance	2-0	*IE-101 Indust. Managment Lect.	
Total Units	16-6	Mc-401 Exterior ballistics	3-0
Intermissional Field Trip		Total Units	16-4

Winter Term		Spring Term	
EE-671 Transient Electro-Mech.	3-4	EE-672 Servo Mechanisms	3-4
Mt-201 Physical Metallurgy	3-2	Mc-421 Interior ballistics	2-0
Ch-631 Physical Chemistry	3-2	Mt-202 Physical Metallurgy	3-2
*IE-103 Indust Management Lect.		Ch-541 Reaction Motors	2-2
Mc-402 Dynamics of a Rigid Body	3-0	ME-8xx Manufacturing Engineering	3-2
Ma-351 Statistics	2-2	*IE-104 Ind. Management lect.	
	14-10	Ma-352 Statistics	2-0
			15-10

THIRD YEAR (03)
at Purdue University

Fall Term		Spring Term	
GE-128 Motion & time study	3	GE-185 Production Control	3
GE-183 Production Planning	3	GE-186 Plant Layout	3
GE-184 Tool design	3	GE-127 Cast Accounting	3
GE-107 Industrial Personnel Relations	3	GE-129 Advanced Motion and Time study	3
GE-91 Elementary accounting	3	GE-231 Production Engineering	3
Psych-173 Personnel Psychology	3	Psych-175 Psychology of Industrial Training	3
Total Units	18		18

ORDNANCE ENGINEERING

Fire Control Curriculum - OC groups

OBJECTIVE

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OC)

Summer Term

Ma-101 Ord. Diff. Equations	5-0
Mc-151 Statics & Kinematics	3-0
EE-151 D.C. Circuits & Fields	3-4
Ch-101 General Chemistry	3-2
OR-205 Surface Fire Control	2-0
	16-6

Fall Term

Ma-102 Series & Vector Algebra	5-0
Mc-152 Kinetics	3-0
EE-251 A.C. Theory	3-4
Ma-106 Complex Var. & LaPlace	4-0
OR-304 A.A. Fire Control	1-2
	16-6

Winter Term

Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0
Mc-153 Further Gen. Laws & Dimen. Anal.	2-0
EE-451 Transformers & Synchros	2-2
Es-261 Electron tubes	3-2
Or-305 A.A. Fire Control	2-0
EE-551 Transmission lines & fltrs.	3-2
*SL-101 New Weapon Dev. Lect.	
Total	17-6

Spring Term

Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
EE-452 A.C. Machines	3-4
ES-262 Electron tubes	3-2
Ma-451 Math. Comp. by Mech. Means	2-0
Mc-201 Topics in Adv. Dynamics	2-2
*SL-102 New Weapon Dev. Lect.	
Total	16-8

*Lecture Course
Intersessional Field Trip.

SECOND YEAR (OC2) at M.I.T.

Fall Term

6.20 Electronic Control & Meas.	3-0-6
6.581 Transients in Linear systems	3-0-9
6.602 Math. Analysis by Mech. methods	3-4-6
6.756 Electrical measurements Lab.	0-4-4
16-41 Introduction to F.C. Instruments	3-0-6
Total	51

Spring Term

6.291 Radar Principle	3-4-6
6.34 Elec. Communications Lab.	0-4-4
6.605 Servomechanisms	3-0-6
16.42 Adv. F.C. Instruments	4-0-8
16.46 Adv. F.C. Instruments Lab.	0-8-0
Total	50

Intermissional Field Trip.

THIRD YEAR (OC3) at M.I.T.

Fall Term

6.292 Radar Principle & Application	3-4-6
6.606 Servomechanisms	3-3-6
6.607 Servomechanisms Lab.	0-12-0
16.45 Adv. F.C. Instruments	4-0-8
Total Units	49

Spring Term

6.681 Special Problems in F.C.	6-0-12
Thesis	30
Total Units	48

ORDNANCE ENGINEERING

Aviation Ordnance Curriculum OE groups

OBJECTIVE

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-111 Statics & Kinematics	5-0	EE-251 A.C. Circuits	3-4
EE-151 D.C. Circuits & Fields	3-4	Mc-112 Kinetics	3-0
Ch-101 General Chemistry	3-2	ME-531 Strength of Materials	3-0
	16-6	AE-100 Basic Aerodynamics	3-4
		AE-001 Aeronautical Lecture	0-1
			17-8
Winter Term		**Spring Term**	
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104 Part. Diff. Eq. & Rel. Topics.	5-0
EE-451 Transformers & Synchros	2-2	EE-452 A.C. Machines	3-4
Mt-201 Physical Metallurgy	3-2	Mt-202 Physical Metallurgy	3-2
Ae-121 Technical Aerodynamics	3-2	AE-136 Aerodynamics performance	3-2
*SL-101 New Weapon Dev. Lect.		OR-103 Ord. Admin. & special equipage	2-0
Total	13-6	*SL-102 New Weapons Dev. Lect.	
*Lecture Course		Total	16-8
Intersessional Field Trip.			

SECOND YEAR (OE2)
at Naval Postgraduate School

Summer Term		Fall Term	
Ma-155 Selected Adv. Topics	3-0	Mc-401 Exterior Ballistics	3-0
Ae-501 Theoretical Aerodynamics I	4-0	Ae-502 Theoretical Aerodynamics II	4-0
EE-551 Transmission line & filters	3-2	Ma-401 Math. Comp. by Mech.Means	2-0
EE-751 Electronics	3-4	Ma-106 Compl. Var. & LaPlace Tr.	4-0
		*IE-101 Industrial Eng. Lect.	
Total	13-6	AE-001 Aeronautical Lect.	0-1
		EE-755 Vacum tubes & Circuits	3-4
		Total	16-5
Winter Term		**Spring Term**	
EE-671 Transients	3-4	EE-753 Gas tubes	1-2
Mc-402 Dynamics of a Rigid Body	3-0	EE-672 Servomechanisms	3-4
Ae-146 Aircraft Dynamics	3-2	Mc-201 Topics in Adv. Dynamics	2-2
Ch-521 Plastics	3-2	Es-441 Introduction to Radar	2-2
OR-404 Guided Missile Guidance	2-0	Mt-203 Metals-Light Alloy	2-2
*SL-101 New Weapons Dev. Lect.		OR-405 Guided Missile Guidance	1-0
*IE-103 Industrial Eng. Lect.		*SL-102 New Weapons Dev. Lect.	
Total Units	14-8	*IE-104 Industrial Eng. Lect.	
		Total Units	11-12

Intermissional Field Trip.

THIRD YEAR
at. M. I. T.

Fall Term		Spring Term	
6.003 Principles of Elec. Engrg.	3-0-6	6-606 Servomechanisms	3-3-6
6.756 Elec. Engineering Lab.	0-304	6.607 Servomechanisms Lab.	0-12-0
16.15 Adv. Airplane Stability & Control	3-0-6	16.44 Adv. F.C. Instruments	3-0-8
16.41 Introduction to F.C. Instrt.	3-0-6	16.46 Adv. F.C. Instmts. Lab.	0-8-0
16.43 F.C. Instruments Lab.	0-8-0	Thesis	0-7-0
Thesis	0-8-0	Total Units	50
Total Units	50		

Summer Term

Thesis 0-3-0

ORDNANCE ENGINEERING

Guided Missile Guidance Ordnance Curriculum-OG groups

OBJECTIVE

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OG)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series and Vector Algebra	5-0
Mc-151 Statics & Kinematics	3-0	Mc-152 Kinetics	3-0
EE-151 D.C. Circuits & Fields	3-4	EE-251 A.C. Circuits	3-4
Ch-101 General Chemistry	3-2	Ae-100 Basic Aerodynamics	3-4
Or-205 Surface Fire Control	2-0	OR-304 A.A. Fire Control	1-2
	16-6		15-10

Winter Term		Spring Term	
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104 Par. Diff. Eq. & Rel.Topics	5-0
Mc-153 Further Gen. Laws & Dimen. Anal.	3-0	Ma-451 Math. Comp. by Mech. Means	2-2
EE-451 Transformers & Synchros	2-2	EE-452 A.C. Machinery	
OR-305 A.A. Fire Control	2-0	OR-103 Ord. Adm. & Special Equip.	2-0
*SL-101 New Weapons Dev. Lect.		*SL-102 New Weapons Dev. Lect.	0-1
OR-404 Guided Missile Guidance	2-0	OR-405 Guided Missile Guidance	1-0
Ae-121 Tech. Aerodynamics	3-2	Ae-136 Aerodynamics performance	3-2
	17-4		15-6

*Lecture Course
Intersessional Field Trip.

SECOND YEAR (OG2)

Summer Term		Fall Term	
Ma-155 Selected Adv. Topics	3-0	Mc-401 Exterior Ballistics	3-0
EE-551 Transmission Line & Filter	3-2	Ma-106 Complex Var. & LaPlace	4-0
EE-751 Electronics	3-4	EE-755 Vacuum tubes & Circuits	3-4
Ae-591 Theoretical Aerodynamics I	4-0	Ae-502 Theoret. Dynamics II	4-0
	13-6	*IE-101 Indust. Eng. Lect.	
		ME-141 Chem. Eng'y.Thermo	4-2
			18-6

Winter Term		Spring Term	
Mc-402 Dynamics of a rigid Body	3-0	EE-753 Gas tubes	1-2
EE-671 Transients	3-4	EE-672 Servomechanisms	3-4
Ae-503 Sonic & Transonic Aerodynmcs	3-2	Ae-431 Aircraft Gas turbines & Jet Propulsion	2-2
Ch-631 Thermodynamics of Ballistics	3-2	Ch-541 Jet Propulsion	2-2
*SL-101 New Weapons Dev. Lect.		*SL-102 New Weapons Dev. Lect.	
*IE-103 Indust. Eng. Lect.		*IE-104 Industrial Eng. Lect.	
ME-142 Chem. Eng'y Thermo	2-2	Mc-201 Topics in Adv. Dynamics	2-2
	14-10		10-12

Intersessional Field Trip.

THIRD YEAR (OG3)

at selected institution, curriculum under revision

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ORDNANCE ENGINEERING

Jet Propulsion Ordnance Curriculum - OJ groups

OBJECTIVE

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OJ)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series and Vector Algebra	5-0
Mc-151 Statics & Kinematics	3-0	Ae-100 Basic Aerodynamics	3-4
EE-151 A.C. Circuits & Fields	3-4	OR-304 A.A. Fire Control	1-2
Ch-101 General Chemistry	3-2	EE-251 A.C. Circuits	3-4
Or-205 Surface Fire Control	2-0		12-10
	16-6		

Winter Term		Spring Term	
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104 Par. Diff. Equations	5-0
EE-451 Transformers & Synchros	2-2	Ph-540 Kinetic theory of gases	3-0
Mt-201 Physical Metallurgy	3-2	Mt-202 Physical Metallurgy	3-2
Ch-411 Physical Chemistry	2-2	Ch-412 Physical Chemistry	2-2
OR-305 A.A. Fire Control	2-0	OR-103 Ord. Admin. & Equipage	2-0
*SL-101 New Weapons Dev. Lect.		*SL-102 New Weapons Dev. Lect.	0-1
	14-6		15-4

*Lecture Courses
Intersessional Field Trip.

SECOND YEAR (OJ2)

Summer Term		Fall Term	
EE-751 Electronics	3-4	Ma-106 Complex Var. & LaPlace Tr.	4-0
Mt-301 High Temp. Metals	2-2	EE-755 Electronic Control & Meas.	3-4
AE-501 Theoretical Aerodynam.	4-0	AE-507 Theoret. Aerodynamics	4-0
OR-404 Guided Missiles	2-0	OR-405 Guided Missiles	1-0
		*IE-101 Indust. Management Lect.	
Total	11-6	ME-141 Chem. Eng'r. Thermo.	4-2
		Total	16-6

Winter Term		Spring Term	
AE-503 Transonic and Supersonic Aero	3-2	AE-431 Gas turbines & jet Propuls.	2-2
ME-500 Strength of Materials	3-0	Ch-541 Reaction Motors	2-2
ME-601 Mat. Testing Lab.	0-2	EE-672 Servomechanisms	3-4
EE-671 Transients	3-4	*IE-104 Ind. Management Lect.	
ME-142 Chem. Eng'r Thermo	2-2	ME-143 Chem. Eng'r. Thermo	4-4
*IE-103 Ind. Management Lect.			
	11-10		11-12

Intersessional Field Trip.

THIRD YEAR (OJ3)

at selected institution, curriculum under revision.

ORDNANCE ENGINEERING

Metallurgical Ordnance Curriculum - OM groups

OBJECTIVE

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OM)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series and Vector Algebra	5-0
Mc-151 Statics & Kinematics	3-0	Mc-152 Kinetics	3-0
EE-151 D.C. Circuits and Fields	3-4	EE-251 A.C. Theory & Circuits	3-4
Ch-101 General Chemistry	3-2	Mt-101 Production Metallurgy	2-0
OR-205 Surface Fire Control	2-0	Ch-221 Qualitative Analysis	3-2
	16-6		16-6

Winter Term		Spring Term	
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
Mc-153 Further Gen. Laws & Dimen. Anal	2-0	OR-103 Ord. Administration	2-0
EE-451 Transformers	2-2	Ch-412 Physical Chemistry	2-2
Ch-411 Physical Chemistry	2-2	Mt-201 Physical Metallurgy	3-2
Ch-231 Analytical Chemistry	2-4	*SL-102 New Weapons Dev. Lect.	
*SL101 New Weapons Dev. Lect.	0-1	Ch-521 Plastics	3-2
	13-9		15-6

*Lecture Course.
Intersessional Field Trip.

SECOND YEAR (CM2)

Summer Term		Fall Term	
EE-751 Electron tubes & Ckts.	3-4	EE-755 Electronic Control & meas.	3-4
Ma-155 Selected Adv. Topics	3-0	Mc-431 Strength of Guns	3-0
CH-531 Phys. Chem. of Mettallurgy	2-0	Mt-204 Adv. Metallurgy	3-4
CR-271 Crystallography and X-ray Techniques	3-2	Mt-301 High Temp. Materials	2-2
Mt-202 Phys. Metallurgy	3-2	*IE-101 Prin. of Ind. Eng. Lect.	
	14-8		11-10

Winter Term		Spring Term	
Ph-610 Atomic Physics	3-0	Mt-303 Metals Seminar	1-0
Mt-205 Adv. Metallurgy	3-4	Ma-301 Statistics	3-2
Mt-102 Production Met. (ferrous)	3-0	Mt-206 Adv. Metallurgy	3-2
Mt-302	4-2	Mc-421 Interior Ballistics	2-0
ME-500 Strength of Materials	3-0	Mt-103 Prod. Met. (non-ferrous)	3-0
ME-601 Materials Testing Lab.	0-2	*IE-104 Indust. Management Lect.	
*IE-103 Indust. Mngmt. Lect.	____	ME-632 Experimental Stress Anal.	2-2
	16-8		14-6

Intersessional Field Trip

ORDNANCE ENGINEERING

THIRD YEAR (OM3)
AT CARNEGIE INSTITUTE OF TECHNOLOGY

Fall Term			Spring Term		
GE-667a	Adv. Mech. Metallurgy	2-0	GE-667b	Adv. Mech. Metallurgy	2-0
E -661	Mod. Met. Practice	0-2	E -662	Mod. Met. Practice	0-2
GE-697	Ordnance Metallurgy	2-0	E -697	Welding Mat.	2-4
GE-663c	Radiography	0-2	E- 660	Met. Engineering	4-0
GE-674a	Graduate Seminar	0-0	GE-674b	Grad. Seminar	0-0
E -647	Non-Fer Metallog	3-3		Theory of Metals	2-0
	Theory of Metal 2-0	2-0			
		9-7			10-6

ORDNANCE ENGINEERING

Chemical Ordnance Curriculum - OP groups

OBJECTIVE

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OP)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series and Vector Algebra	5-0
Mc-151 Statics & Kinematics	3-0	EE-251 A.C. Theory & Circuits	3-4
EE-151 D.C. Circuits & Fields	3-4	Ch-221 Qualitative Analysis	3-2
Ch-101 General Chemistry	3-2	Ch-311 Organic Chemistry	3-2
Ord205 Surface Fire Control	2-0		
	16-6		14-10

Winter Term		Spring Term	
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Or-501 Under water Ordnance	2-0
EE-451 Transformers	2-2	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
Ch-231 Quantitative Chem.	2-4	Or-103 Admin. & Spec. Equip. (Ord)	0-2
Ch-411 Physical Chem.	2-2	Ph-540 Kinetic Theory of Gases	3-0
*SL-101 New Weapons Dev. Lect.	0-1	Ph-311 Physics (E & M)	3-0
Ch-312 Organic Chemistry	3-2	Ch-412 Physical Chemistry	2-2
	14-10	*SL-102 New Weapons Dev. Lect.	
			15-4

*Lecture Course.
Intersessional Field Trip.

SECOND YEAR (OP2)

Summer Term		Fall Term	
EE-751 Electron tubes & Ckts.	3-4	EE-755 Electronic Control Meas.	3-4
Ma-155 Selected Adv. Topics	3-0	Ch-321 Organic Chem. (ADV)	2-2
OR-503 Underwater Ordnance	2-0	ME-141 Chem. Eng'r. Thermo	4-2
Cr-271 Crystallography and X-ray Techniques	3-2	Mc-431 Strength of Guns	3-0
Ch-701 Chemical Calculation	3-2	Ch-323 High Polymer Chem.	2-0
	14-8	*IE-101 Indust. Eng. Managmnt. Lect.	
			14-8

Winter Term		Spring Term	
Ph-610 Atomic Physics	3-0	Ch-541 Rocket Motors	2-2
Ch-322 Organic Chem. (Spec. top)	3-3	Mt-202 Phys. Metallurgy	3-2
Mt-201 Phys. Metallurgy	3-2	Ch-800 Chem. Seminar	1-0
Ch-521 Plastics	3-2	Mc-421 Interior Ballistics	2-0
ME-142 Chem. Eng'r. Thermo.	2-2	ME-143 Chem. Eng'r. Thermo.	4-4
*IE-103 Indust. Management Lect.	———	*IE-104 Indust. Management Lect.	———
	14-9		12-10

Intersessional Field Trip.

THIRD YEAR (OP3)

at selected institution, curriculum under revision.

ORDNANCE ENGINEERING

Physics Electronics Ordnance Curriculum-OR-groups

OBJECTIVE

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OR)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series and Vector Algebra	5-0
Mc-151 Statics & Kinematics	3-0	Mc-152 Kinetics	3-0
EE-151 D.C. Circuits & Fields	3-4	EE-251 A.C. Theory	3-4
Ch-101 General Chemistry	3-2	Ae-100 Basic Aerodynamics	3-4
OR-205 Surface Fire Control	2-0		14-8
	16-6		
Winter Term		**Spring Term**	
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
EE-451 Transformers	2-2	Es-114 Circuit Analysis & Meas.	3-3
Es-113 Circuit Analy. & Meas.	3-3	Es-262 Electron tubes	3-2
Es-261 Electron tubes	3-2	Es-226 Ultra High Freq. Tubes	4-3
Mc-153 Further Gen. Laws & Dimen. Anal.	3-0	SL 102	15-8
SL-101			
*Lecture Course	16-7		
Intersessional Field Trip			

SECOND YEAR (OR2)

Summer Term		Fall Term	
Es-263 Electron tubes	3-2	Es-126 R.F. meas.	2-6
Es-431 Radar	3-3	Es-432 Radar Systems	3-6
Es-756 Wave Guides & Antennas	3-3	Or-304 A.A. F. C.	1-2
Ph-211 Heat & Geo. Optics	3-0	Ae-502 Theo.Aerodynamics	4-0
Ae-501 Theo. Aerodynamics	4-0	IE-101	10-14
	16-8		
Winter Term		**Spring Term**	
Es-121 Adv. Circuit Theory	3-2	EE-672 Servomechanisms	3-4
Ch-631 Physical Chemistry	3-2	Es-122 Adv. Circuit Theory	3-2
AR-503 Sonic & Transonic Aero	3-2	Ch-541 Reachion Motors	2-2
OR-305 A.A. F. C.	2-0	OR-405	1-0
OR-404 Guided Missile Guide	2-0	OR-103	2-0
IE-103		IE-104	11-8
	13-6		
Intersessional Field Trip			

THIRD YEAR (OR3) at M.I.T.

Fall Term		Spring Term	
6.501A Elec. Eng. Seminar	2-0-12	6.502A Elec. Eng. Seminar	2-0-2
6.561A Network Theory Adv.	3-0-6	6.562A Network Theory Adv.	3-0-6
6.621A Radio Lines Antenna & Propagation	3-0-6	6.622A Radio Lines & Propagation	3-0-6
6.322B Prin. of Elec. Commun.		Thesis	28
Thesis	10		50
	51		

ORDNANCE ENGINEERING

Mechanical Electrical Propulsion Ordnance Curriculum-OT groups

OBJECTIVE

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OT)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	M -102 Series & Vector Algebra	5-0
Mc-151 Statics & Kinematics	3-0	Mc-152 Kinetics	3-0
EE-151D D.C. Circuits & Fields	3-4	EE-251 A.C. Theory	3-4
Ch-101 General Chemistry	3-2	Ae-100 Basic Aerodynamics	3-4
OR-205 Surface Fire Control	1-0		14-8
	16-6		
Winter Term		**Spring Term**	
EE-451 Transformers & Synchros	2-2	EE-452 A.C. Machines	3-4
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
Mc-153 Further Gen.Laws & Dimen. Anal.	3-0	Mc-201 Topics in Adv. Dynamics	2-2
Mt-201 Phys. Metallurgy	3-2	Mt-202 Phys. Metallurgy	3-2
ME-500 Strength of Materials	3-0	Or-501 Underwater Ordnance	2-0
ME-601 Materials Lab.	0-2		15-8
*SL-101 New Weapons Dev. Lect.	0-1	*Lecture Course	
	16-6	Intermissional Field Trip	

SECOND YEAR (OT2)

Summer Term		Fall Term	
Mt-301 High Temp. Metallurgy	2-2	Ma-106 Complex Var. & LaPlace Tr.	4-0
EE-551 Trans. Lines & filters	3-2	EE-755 Electronics Control & Meas.	3-4
EE-751 Vacum tubes & Circuits	3-4	ME-141 Chem. Eng'r. Thermo.	4-2
Ae-501 Theo. Aerodynamics	4-0	Ae-502 Theo Aerodynamics	4-0
Or-503 Underwater Ordnance	2-0	*IE-101 Ind. Management Lect.	
	14-8		15-6
Winter Term		**Spring Term**	
EE-671 Transients	3-4	EE-672 Servomechanism	3-4
Ch-551 Water Reaction Fuels	2-2	EE-753 Gas tubes	1-2
*IE-103 Ind. Management Lect.		Ch-541 Reaction motors	2-2
ME-142 Chem. Eng'y. Thermo.	2-2	ME-143 Chem. Eng'y. Thermo.	4-4
Mt-203 Physical Metallurgy	2-2	*IE-104 Ind. Management Lect.	
Ae-503 Sonic & Trans-sonic Aerodynamics	3-2		10-12
	12-12	Intersessional Field Trip	

THIRD YEAR (OT3) at M.I.T.

Fall Term		Spring Term	
6.606 A Servomechanisms	3-3-6	2.214 A Gas Turbines	3-0-9
6.607 A Servomechanisms	0-12-0	16.42 A- Adv. F.C. Instruments	4-0-8
2.213 A Gas tubes	3-0-9	Thesis	0-25-0
Thesis	10		49
	49		

ORDNANCE ENGINEERING

Subsurface physics Electronics Ordnance Curriculum OW groups

OBJECTIVE

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equation	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-151 Statics & Kinematics	3-0	Ph-211 Optics	3-0
EE-151 D.C. Circuits & Fields	3-4	EE-251 A.C. Theory	3-4
Ch-101 General Chemistry	3-2	Ae-100 Basic Aerodynamics	3-4
Or-205 Surface Fire Control	2-0		
	16-6		14-8

Winter Term		Spring Term	
Es-113 Circuit Analysis & Meas.	3-3	Or-501 Underwater Ordnance	2-0
EE-451 Transformer & Synchros	2-2	Or-103 Ord. Admin & Spec. Equip.	2-0
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	EE-452 A.C. Machines	3-4
Ph-212 Dynamics & Optics	3-3	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
	13-8	Ph-113 Dynamics	3-0
			15-4

*Lecture Course
Intersessional Field Trip

SECOND YEAR (OW2)

Summer Term		Fall Term	
Or-503 Under water Ordnance	2-0	EE-755 Electronic Control & Meas.	3-4
EE-551 Trans. Lines & filters	3-2	Ma-106 Complex Var. & LaPlace Tr.	4-0
EE-751 Electronics	3-4	Ph-422 Sound	3-0
Ph-421 Sound	3-0	Ae-502 Theo Aerodynamics	4-0
Ae-501 Theo. Aerodynamics	4-0	Me-111 Thermodynamics	4-2
	15-6		18-6

Winter Term		Spring Term	
EE-671 Transients	3-4	EE-672 Servomechanisms	3-4
Ph-610 Atomic Physics	3-0	EE-753 Gas tubes	1-2
Ph-423 Sound	2-3	Ph-424 Sonar Systems	2-4
Me-112 Thermodynamics	4-2	Ph-311 Elect. and Magnetism	3-0
		Ph-540 Kinetic Theory	3-0
	12-9		12-10

Intersessional Field Trip

THIRD YEAR (OW3)

at selected institution, curriculum under revision

ORDNANCE ENGINEERING

Special Physics Ordnance Curriculum - OX groups

OBJECTIVE

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

FIRST YEAR (OX)

Summer Term		Fall Term	
Ma-101 Ord. Diff. Equations	5-0	Ma-102 Series & Vector Algebra	5-0
Mc-151 Statics & Kinematics	3-0	EE-251 A.C. Theory	3-4
EE-151 D. C. Circuits & Fields	3-4	Ph-251 Geo. & Phys. Optics	3-2
Ch-101 General Chemistry	3-2	Ma-106 Complex Var. & LaPlace	4-0
Or-205 Surface Fire Control	2-0	Or-304 A.A. Fire Control	1-2
	16-6		16-8

Winter Term		Spring Term	
Ma-103 Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104 Part. Diff. Eq. & Rel. Topics	5-0
Ph-252 Dynamics	3-2	Ph-153 Dynamics	3-0
EE-451 Transofrmers & Synchrose	2-2	EE-651 Transients & Servos	3-4
Es-261 Electron tubes	3-2	Es-262 Electron tubes	3-2
Es-113 Circuits & Lines	3-3	Es-114 Filters	3-3
*SL-101 New Weapons Dev. Lect.	0-1	*SL-102 New Weapons Dev. Lect.	0-1
	16-10		17-10

SECOND YEAR (OX2) at M. I. T.

Summer Term (first half)		Summer Term (second half)	
6.20 Elect. Cont. & Meas.B	3-O-6	6.20 Elect. Cont. & Meas. B	3-0-6
6.756 Elec. Meas. Lab.	0-2-2	6.756 Elect. Meas. Lab.	0-6-6
8.062 Intermediate Physics	8-0-12	6.003 Elec. Eng. Prin.	6-0-6
	33		33

Fall term			Spring Term		
8.05 Atomic Structure		4-0-6	8.06 Nuclear Physics, Int.	B	4-0-6
8.07 Intermediate Physics		4-0-5	8.10 Lab.		0-6-6
6.311 Elec. Com. Prin.	B	3-0-6	8.462 Introduction to Th. Physics II		4-0-8
6.34 Elec. Com. Prin.	B	0-4-4	6.34 Elec. Com. Prin.	B	0-3-3
L41 Scientific German		3-0-6	6.623 Pulse Circuits Prin.	A	3-0-6
Intersessional Field Trip.		45			49

THIRD YEAR (OX3) at M. I. T.

Fall Term			Spring Term		
8.411 Nuclear Physics I	A	3-0-6	8.412 Nuclear Physics II	A	3-0-6
8.44 Int. to Nuclear Eng.	A	3-0-6	8.413 Nuclear Physics Lab.	A	0-3-3
8.45 Sp.Prob.In Nuclear Physics	A	10	Thesis	A	30
8.461 Int. to Th.Physics I	B	4-0-8			45
6.624 Electrodyn.of Particles	A	3-0-6			
		49			

ATOMIC ENERGY ENGINEERING

General Atomic Energy Curriculum-RX-groups

OBJECTIVE

The objective of this curriculum is to train specially selected officers of the Armed Forces in the fundamental sciences in order to have available a number of well trained highly competent officers capable of assuming positions of leadership in atomic energy matters to whatever extent may be demanded in the future.

FIRST YEAR (RX)

Summer Term		Fall Term	
Ma-181 Part. Deriv. & Ord. Diff.Eqs.	5-0	Ma-182 Vect. Anal. & Complex Var. Part I	5-0
Ph-640 Atomic Physics	3-3	Ph-240 Optics & Optical Spectra	3-3
Ch-102 General Chemistry	4-2	Ph-341 Electricity & Magnetism	3-0
Mt-201 Physical Metallurgy	3-2	Ch-213 Analytical Chemistry	3-4
	15-7		14-7

Winter Term		Spring Term	
Ma-183 Vect. Anal. & Complex. Var. Part II	5-0	Ma-184-Special Math. Methods of Physics	5-0
Ph-140 Dynamics	4-0	Ch-442 Physical Chemistry	4-2
*Ph-342 Electronics	3-3	*Ph-343 Electronics & Radiation Measurements	2-3
*Ch-315 Organic Chemistry	4-3	*Ph-540 Kinetic theory	3-0
	16-6	Elective	4-0
			18-5

* for Army engineers only, other students elective in accordance with ability, major field of interest and scholastic background.

SECOND YEAR

at a Civilian institution to be selected. Curricula to be determined in accordance with individual specialties.

ATOMIC ENERGY ENGINEERING

Radiological Defense Curriculum -RZ- groups

OBJECTIVE

The objective of this curriculum is to train officers of the Armed services in the fundamental sciences especially in those pertaining to nuclear and medical physics and associated with the problems that arise from the applications of atomic energy.

FIRST YEAR (RZ)

Summer Term		Fall Term	
Ma-181 Part. Deriv. & Ord. Diff. Eqs.	5-0	Ma-182 Vect. Anal. & Complex Var. Part I	5-0
Ph-640 Atomic Physics	3-3	Ph-240 Optics & Optical Spectra	3-3
Ch-102 General Chemistry	4-2	Ph-341 Elect. & Magnetism	3-0
Mt-101 Meteorology	3-0	Ch-213 Analytical Chemistry	3-4
	15-5		14-7

Winter Term		Spring Term	
Ma-183 Vect. Anal. & Complex. Var. Part II	5-0	Ma-184 Special Math. Methods of Physics	5-0
Ph-342 Electronics	3-3	Ph-343 Electronics & Radiation Measurements	2-3
Ph-140 Dynamics	4-0	Ph-540 Kinetic theory	3-0
Ch-315 Organic Chemistry	4-3	Ch-442 Phys. Chem. Biology & Physiology	4-0
Total Units	16-6	Total Units	18-5

SECOND YEAR (RZ2)
at University of California

Summer Term

Zoology 10	- General Human Biology	-3
Chem. (Spec.)	- Radiation Measurements	-3
	- Radiation Measurements Lab.	-3
Physiology S1-A, S10	- General Physiology	-5
		14

Fall Term		Spring Term	
Chem. 123 Nuclear Chemistry	2	Phys. 126 Medical Physics	3
Phys. 125 Medical Physics	1	Chem. 223 Adv. Radioactivity	2
Phys. 100B General & Comparative Physiology	3	Med. Phys. 100D Biological Aspects of Radiation	3
Phys. 121 Intro. to Atomic Structure	3	Phys. 115 Intro. to Quantum Mechanics	2
Phys. 110D Modern Physics Lab.	1	Phys. 124 Radioactivity & Nuclear Structure	3
Phys. 105A Analytical Mechanics Mathematics	3	Phys. 105B Analytical Mechanics	3
Total	16		16

THIRD YEAR (RZ3)
at University of California

Summer Term--Field Trip

Fall Term	Spring Term		
Field Trip	Phys. 224	Nuclear Physics	-3
	Phys. 290	Seminar	1-3
	Phys. 295	Thesis	1-6
			2-12

PART III

Course Descriptions

AERONAUTICS

Ae Courses

Aeronautical Lecture Series	Ae-001
Basic Aerodynamics	Ae-100
Technical Aerodynamics	Ae-121
Technical Aerodynamics - Performance	Ae-131
Flight Analysis	Ae-132
Aircraft Performance - Flight Analysis	Ae-136
Dynamics	Ae-141
Dynamics	Ae-142
Dynamics	Ae-146
Stress Analysis	Ae-201
Stress Analysis	Ae-202
Stress Analysis	Ae-203
Stress Analysis	Ae-204
Airplane Design	Ae-311
Airplane Design	Ae-312
Advanced Aircraft Structures	Ae-321
Aircraft Engines	Ae-411
Aircraft Propulsion	Ae-421
Internal Flow in Aircraft Gas Turbines	Ae-431
Hydro-aero-mechanics	Ae-501
Hydro-aero-mechanics	Ae-502
Compressibility	Ae-503

AERONAUTICS (Aeronautical Lecture Series) 0-2 Ae-001

Objective: To acquaint the student with the nature and scope of the work and problems in the various fields of Aeronautical Engineering.

Description: The course consists of a series of lectures by prominent authorities from the Bureau of Aeronautics, research laboratories, and from industry.

Prerequisites: None.

AERONAUTICS (Basic Aerodynamics) 3-4 Ae-100

Objective: To train the student in the fundamentals of fluid mechanics as a foundation for future work in Aeronautics.

Description: The course includes: Properties of fluids; statics of fluids; flotation; Bernoulli's theorem; fluid velocity and pressures; pitotstatic tube; the venturi tube; cavitation; theory of lift; circulation; blade screws and propellers; vicosity; viscous flows; vertices; flow in pipes; flow through orifices; laminar and turbulent boundary layer flows; separation phenomena; surface friction; resistance of floating bodies; dynamics of compressible fluids.

The P.W. periods include experimental work in the wind tunnel, allied to the topics above; technical analysis and report writing.

Prerequisites: None

AERONAUTICS (Technical Aerodynamics) 3-2 Ae-121

Objective: To continue the study of the fundamental technical aerodynamics begun in Ae-100.

Description: The course includes: characteristic flows and pressures about bodies; surface friction; wake drag; aerodynamic characteristics of airfoil sections, three dimensional air foil theory; induced drag; aspect ratio corrections; biplanes; interference drag; high lift devices; velocity polar; relative motion.

The P.W. periods include wind tunnel experiments, analysis and technical report writing on topics allied to the above class work.

Prerequisite: Ae-100

AERONAUTICS (Technical Aerodynamics - Performance) 4-2 Ae-131

Objective: To train the student in the fundamentals of aircraft performance.

Description: The course includes: the aerodynamic characteristics of the airplane; the propeller and engine characteristics; sea level performance; performance at altitudes; superchargers; range and endurance; special performance problems; charts.

The P.W. periods are devoted to computations and performance analysis.

Prerequisites: Ae-100, Ae-121.

AERONAUTICS (Flight Analysis) 3-2 Ae-132

Objective: To study the comparitive performance of aircraft, flight test analysis, and special flight problems.

Description: The course includes: Parametric study of aircraft performance, flight test procedure, flight data reduction, special flight problems.
Practical work: Practical problems dealing with the above.

Prerequisites: Ae-100; Ae-121; Ae-131.

AERONAUTICS (Aircraft Performance - Flight Analysis) 3-2 Ae-136

Objective: To study the fundamentals of aircraft performance, performance parameters, and flight analysis.

Description: The course includes: aerodynamic characteristics of composite aircraft; propeller and engine characteristics; aircraft performance; range and endurance; special performance problems; performance parameters; flight test reduction and analysis.
Practical work: Anaalysis of performance of an aircraft will be made based upon wind tunnel tests in the laboratory - practical problems from flight test will also be analyzed.

Prerequisites: Ae-100; Ae-121.

AERONAUTICS (Dynamics, I) 3-4 Ae-141

Objective: To acquaint the student with the fundamentals of the static and dynamic longitudinal stability of the airplane and its motion in the longitudinal plane.

Description: The course includes: fundamental definitions, the forces and moments of the entire plane, the equation of motion, the moments of the wing, the moments of the tail, downwash, C. G. location, C. G. for N. S., locked control stability, free control stability, dynamic longitudinal stability, the force and moment derivatives, motion in the longitudinal plane.
The P.W. consists of wind tunnel experimentation and analysis on the longitudinal flight and stability characteristics of a model of an airplane.

Prerequisites: Ae-100, Ae-121, Ae-131.

AERONAUTICS (Dynamics, II) 3-4 Ae-142

Objective: To continue the study of the dynamics of the airplane with particular attention to the stability and characteristics of lateral motion, the maneuverability and controllability of the airplane.

Description: The course includes: Lateral motion, directional stability, spiral and directional divergence, dynamic stability equations, force and moment derivatives, maneuverability, controllability, three dimensional motion, spins. Associated field work as can be arranged at Langley Field, Wright Field, and the D. W. Taylor Laboratories.
The P.W. consists of wind tunnel experimentation and analysis of the lateral motion characteristics of an airplane.

Prerequisite: Ae-141.

AERONAUTICS (Dynamics) 3-2 Ae-146

Objective: To study the static and dynamic stability, the controllability and the maneuverability of aircraft in motion thru air.

Description: The course includes fundamental definitions, forces and moments of composite aircraft, equations of motion, static stability and trim, effects of CG location, static margins, free control stability, dynamical longitudinal stability, dynamic lateral stability, force and moment derivations, stability charts, controllibility, maneuverability, three dimensional motions, spins. The P.W. consists of experimentation and analysis of static and dynamic stability of some particular aircraft.

Prerequisites: Ae-100; Ae-121; Ae-131 or Ae-136.

AERONAUTICS (Stress Analysis) 4-2 Ae-201

Objective: To supply methods of stress analysis beyond the elementary stage as required for the design of structural and mechanical components of aircraft, with applications.

Description: The course is in continuity with ME-531, and emphasizes digrammatic methods, applied especially to: analysis of beams including statically indeterminate cases, frame elements, variable cross section, shearing effect on bending displacement; plane stress, principal stresses; influence lines and elementary applications.

Prerequisites: Ma-102; Mc-112; ME-531.

AERONAUTICS (Stress Analysis) 4-2 Ae-202

Objective: To supply methods of stress analysis at intermediate levels and apply them to aircraft components.

Description: This course is in continuity with Ae-201 and considers: strain energy, applications to impact loading, Castigliano theorem, displacement calculations, redundant trusses; virtual energy, applications to deflection and statically indeterminate problems, Maxwell-Mohr method; law of reciprocal deflections; influence line application to deflections; buckling of bars, the flexible column, critical loads, energy methods; curved bars.

Prerequisite: Ae-201.

AERONAUTICS (Stress Analysis) 4-0 Ae-203

Objective: To supply methods of stress analysis at advanced levels, and apply them to aircraft components.

Description: This course is in continuity with Ae-202 and considers: curved bars (continued), rotating machine parts, circular bars in bending and/or twist, energy methods on curved frames, beams loaded by forces not in principal axes of section, cases with unsymmetrical cross-section; short beams in compression and bending, cores; torsions, non-circular sections, membrane analogy, combined with bending, close coiled helical spring, crank throw, thin open or hollow sections, torsional shear flow; center of twist, shear flow; beam columns, single panel, multipanel, charts; beam tie; polar diagrams.

Prerequisites: Ae-202; Me-111.

AERONAUTICS (Stress Analysis) 4-0 Ae-204

Objective: To supply methods of stress analysis at advanced levels and apply them to aircraft components.

Description: This course is in continuity with Ae-203 and considers: thin stiff plates under lateral load, bent to cylinder, in pure bending in two perpendicular directions, axially symmetrical problems; axially symmetrical membrane problems; discontinuity effects in shells, beam on elastic foundation and application, cylinder and hemisphere, flat plate and cylinder, hollow ring and cylinder; thick-walled spheres and cylinders, applications to rotating discs; selected topics from theory of elasticity; stress concentration.

Prerequisite: Ae-203.

AERONAUTICS (Airplane Design, I) 2-4 Ae-311

Objective: To present the general methods of airplane design and to design a small airplane for one condition of loading.

Description: Topics are: critical loading conditions, load-factors, V-g diagrams, strength envelopes, detail methods of layout and analysis of a light plane.

P.W. requirements are for the condition of high angle attack: prepare equipment list and balance diagram; correct airfoil characteristics for structural use; construct three view drawing; run the balance calculation and the preliminaries to the wing design.

Prerequisite: Ae-202.

AERONAUTICS (Airplane Design, II) 2-4 Ae-312

Description: Topics include: wing spar analysis, wing truss analysis, fuselage analysis including Maxwell Diagram; design of one wing spar on basis, (a) shear-resistant web, (b) tension field web, (c) composite spar of two materials; design of elevator torque tube in bending and twist for given loading condition, design of several members of the fuselage truss as columns and as ties; design of indicated fittings.

Prerequisites: Ae-311; Ae-203.

AERONAUTICS (Advanced Aircraft Structures) 4-0 Ae-321

Objective: To supply additional methods of structural analysis at advanced levels, as required in aircraft design, and to apply them to given examples.

Description: Topics include: rectangular plates in pure bending, in bending and under loading in middle surface, buckling, crippling; advanced deflection problems, Williot diagram; deformation in the plastic state; advanced stability considerations, beam columns, rings and tubes, latticed columns, variable section torsional cases.

Prerequisites: Ae-312; Ae-204.

AERONAUTICS (Aircraft Engines) 3-2 Ae-411

Objective: To study the application of thermodynamic and mechanical principles to aircraft engines and turbines.

Description: This course extends the study of combustion with particular reference to piston engine and gas turbine applications. Fuel mixtures, ignition, flame propogation and stability are discussed. Utilization and conversion of combustion energy in engine cycles is considered in both the thermodynamic and mechanical aspects. The latter is continued in a survey of current engine design and construction.

Prerequisite: ME-132.

AERONAUTICS (Aircraft Propulsion) 3-2 Ae-421

Objective: To study the performance of aircraft power plants as a whole, under simulated and actual operating conditions as influenced by airplane requirements and characteristics.

Description: Sea level and altitude performance characteristics of piston engines, propellers, turbo-jet and turbo-prop engines are analyzed. Maximum performance, cruise control, laboratory and flight testing, and test data correction methods are discussed. Aircraft performance is reviewed with particular reference to the propulsion system. The practical work of this course consists of supervised analysis of test data taken at various Naval Air Test Centers.

Prerequisites: Ae-411; Ae-131.

AERONAUTICS (Internal Flow in Aircraft Engines) 4-0 Ae-431

Objective: To acquaint the student with the fundamentals of aircraft gas turbine systems and to provide rational methods for the calculation of continous flow machines.

Description: Momentum theorem, thrust equations, gas turbine cycle analysis, flow equations, relative and absolute flow, relative flow in machines, energy equations, thermodynamic flow equations, axial-flow compressors, centrifugal compressors, axial-flow turbines, centrifugal turbines, control analysis of aircraft gas turbines.

Prerequisite: Ae-503.

AERONAUTICS (Hydro-aero-mechanics, I) 4-0. Ae-501

Objective: To provide a rational background for work in aerodynamics.

Description: Vector Calculus and aerodynamical applications, fluid kinematics and flow description, stream and velocity potential functions, dynamic equations for a perfect fluid, solution by scalar and vector methods, properties of elemental and combined flows, two dimensional problems, use of complex numbers in flow description, conformal transformation, complex integration, Blasius Equations, Kutta-Joukowski Theorem, lift and pitching moment on an infinite wing.

Prerequisites: Ma-114; Ae-131.

AERONAUTICS (Hydro-aero-mechanics, II) 4-0 Ae-502

Objective: To complete the presentation of basic hydro-aero-mechanics.

Description: Viscous Fluids, Navier-Stokes Equation and special solutions, Prandtl Boundary Layer Theory, skin friction, Helmholtz Vortex Theory, the three dimensional airfoil, induced velocity angle of attack, drag, lift distribution, least induced drag tapered and twisted airfoils, chordwise and spanwise load distributional tunnel-wall effect, compressible fluids.

Prerequisite: Ae-501

AERONAUTICS (Compressibility) 4-0 Ae-503

Objective: To study the phenomena of compressible fluids.

Description: Propagation of disturbances, Normal shocks, Flow in channels with varying cross section, Laval nozzle with varying back pressure, Oblique shocks, Reflection of shock fronts, Mach waves, Prandtl-Meyer flow, Hodograph methods, Method of characteristics, Travelling shock fronts, Instationary flow problems.

Prerequisites: ME-132; Ae-502.

CHEMISTRY

Ch Courses

General Inorganic Chemistry	Ch-101
General Inorganic Chemistry	Ch-102
General Chemistry	Ch-102a
Fuel and Oil Chemistry	Ch-111
Fuel and Oil Chemistry	Ch-121
Analytical Chemistry	Ch-201
Analytical Chemistry	Ch-211
Analytical Chemistry	Ch-212
Analytical Chemistry	Ch-213
Qualitative Analysis	Ch-221
Qualitative Analysis	Ch-231
Organic Chemistry	Ch-301
Organic Chemistry	Ch-311
Organic Chemistry	Ch-312
Organic Chemistry	Ch-315
Organic Chemistry, Advanced	Ch-322
Organic Chemistry, High Polymers	Ch-323
Physical Chemistry	Ch-401
Physical Chemistry	Ch-411
Physical Chemistry	Ch-412
Physical Chemistry	Ch-421
Physical Chemistry	Ch-441
Physical Chemistry	Ch-442
Plastics	Ch-521
Physical Chemistry	Ch-531
Reaction Motors	Ch-541
Radio Chemistry	Ch-551
Physical Chemistry	Ch-561
Physical Chemistry, Reaction Motors	Ch-571
Physical Chemistry, Special Fuels	Ch-581
Chemical Engineering Thermodynamics	Ch-611
Chemical Engineering Thermodynamics	Ch-612
Chemical Thermodynamics	Ch-613
Thermodynamics	Ch-631
Chemical Engineering Calculations	Ch-701
Unit Operations in Chemical Engineering	Ch-711
Unit Operations in Chemical Engineering	Ch-712
Seminar	Ch-800

CHEMISTRY (General Inorganic Chemistry) 3-2 Ch-101

Objective: To present the fundamentals of elementary physical chemistry and to provide a background for an appreciation of problems and applications of the subject that may be encountered in the naval service.

Description: The subject matter includes a consideration of general chemical principles such as the modern concept of the atom, kinetic theory, chemical equilibrium, chemical calculations, reaction rates and a brief discussion of the specialized topics corrosion, explosives, etc., which are of special interest to officers in the naval service.

The laboratory work consists of experiments selected to illustrate principles discussed in the lectures.

Prerequisites: None

CHEMISTRY (General Inorganic Chemistry) 4-2 Ch-102

Objective: To give the students in the fields of nuclear energy and radiological defense the theoretical and descriptive background in general chemistry necessary for advanced work.

Description: The topics covered include chemical equilibrium, chemical calculations, kinetic theory, atomic structure, solutions, ionization and also sufficient descriptive material to furnish background for advanced courses.

The laboratory work consists of experiments which will illustrate principles discussed in lecture and which will enable students to develop laboratory technique.

Prerequisites: None.

CHEMISTRY (General Chemistry) 5-2 (Six Weeks) Ch-102a

Objective: To provide the student officers in Radiological Defense a theoretical background in general chemistry. (1947-1948 only)

Description: The following topics are included: Chemical calculations, kinetic theory, modern concept of the atom, chemical equilibrium, solutions and ionization.

The laboratory experiments are selected to clarify the principles discussed in lecture and to develop laboratory technique.

Prerequisites: None.

CHEMISTRY (Fuel and Oil Chemistry) 2-2 Ch-111

Objective: To study the principles of combustion lubrication and the properties of fuels and lubricants.

Description: The subject matter includes the chemistry, properties and production of fuels and lubricants; the theory of combustion and knocking; the theory of fluid film and boundary lubrication and the interpretation of the results of standard test procedures.

The laboratory work includes conducting some of the standard tests on fuels and lubricants and problems on interpretation of data from Orsat analysis and combustion calculations.

Prerequisite: Ch-101.

CHEMISTRY (Fuel and Oil Chemistry) 4-2 Ch-121

Objective: To present the principles of general chemistry, of combustion and lubrication and to study the properties and production of fuels and lubricants.

Description: The subject matter includes a consideration of chemical principles such as atomic structure, states of matter, ionization, chemical equilibrias, etc.; and a survey of the chemistry, properties and production of fuels and lubricants. The theory of lubrication; and the theory of combustion and knocking; and interpretation of the results of standard test procedures.

The laboratory work consists of experiments illustrating principles discussed in the lectures; and performing some of the standard tests on fuels and lubricants.

Prerequisites: None.

CHEMISTRY (Analytical) 4-4 Ch-201

Objective: (1) This course is planned to give the student a background for future study at civilian universities in graduate work. (2) To supply certain prerequisites for advanced work and as a preparation for certain courses in physical chemistry.

Description: This course includes both qualitative and quantitive analysis. It consists of a study of the principles of mass action, common ion effect, and solubility product, and their application to systematic analysis. The laboratory work consists of practical work in characteristic reactions, and in the analysis of known and unknown materials for elements and radicals present.

Prerequisites: Ch-101 or Ch-121.

CHEMISTRY (Analytical) 3-2 Ch-211

Objective: To provide the fundamentals of analytical chemistry as a prerequisite for advanced work at civilian universities.

Description: An abbreviated course in analytical chemistry, combining the principles of both qualitative and quantitative analysis, designed to supply prerequisites for physical chemistry.

Prerequisite: Ch-101 or Ch-121.

CHEMISTRY (Analytical) 3-2 Ch-212

Objective: To provide the fundamentals of analytical chemistry as a prerequisite for a course in radiological defense. (1947-1948 only)

Description: An abbreviated course in analytical chemistry, combining the principles of both qualitative and quantitative analysis. A survey is made of special analytical apparatus and methods.

Prerequisite: Ch-102a.

CHEMISTRY (Analytical) 3-4 Ch-213

Objective: To provide the fundamentals of inorganic and analytical chemistry as a preparation for specialization in radiological defense, and to supply prerequisites in chemistry for graduate work at a civilian university.

Description: This course includes both qualitative and quantitative analysis. It consists of a study of the principles of mass action, common ion effect, and solubility product, and their application to systematic analysis. The laboratory work consists of practical work in characteristic reactions, and in the analysis of known and unknown materials.

Prerequisite: Ch-102.

CHEMISTRY (Qualitative Analysis) 3-2 Ch-221

Objective: This course is designed to supply student groups specializing in certain courses with standard background material in analytical chemistry.

Description: This is the first part in a course in analytical chemistry and is fundamentally qualitative analysis. It consists of a study of chemistry emphasizing the application of principles to systematic analysis. The laboratory work consists of practical work in characteristic chemical reactions and in the analysis of known and unknown solutions for elements and radicals present.

Prerequisite: Ch-101 or Ch-121.

CHEMISTRY (Quantitative Analysis) 2-4 Ch-231

Objective: This course is designed to supply student groups specializing in certain courses with standard background material in analytical chemistry.

Description: This course is a continuation and conclusion of the work begun in the Ch-221 course. The subject matter includes the fundamental principles of quantitative chemistry.

Prerequisite: Ch-221.

CHEMISTRY (Organic) 3-2 Ch-301

Objective: To provide some of the basic fundamentals of organic chemistry.

Description: A brief course in organic chemistry consisting of a discussion of important principles, methods, and classes of compounds in the aliphatic and aromatic series.

Prerequisite: Ch-101 or Ch-121

CHEMISTRY (Organic Chemistry) 3-2 Ch-311

Objective: To provide the fundamentals of organic chemistry as a preparation for a course of study in a civilian university.

Description: A brief course in the chemistry of the aliphatic compounds. Major emphasis is placed on well-recognized basic principles of organic chemistry.

Prerequisites: Ch-101; Ch-111.

CHEMISTRY (Organic Chemistry) 3-2 Ch-312

Objective: To provide the fundamentals of Organic Chemistry as a preparation for a course of study in a civilian university.

Description: This course is a continuation of chemistry Ch-311 with the application of the study to aromatic compounds. Particular emphasis is given to polymer chemistry and the more recent and more important applications.

Prerequisite: Ch-311.

CHEMISTRY (Organic) 3-4 Ch-315

Objective: To provide the fundamentals of organic chemistry as a preparation for specialization in radiological defense, and to supply prerequisites in chemistry for graduate work at a civilian university.

Description: A brief course in organic chemistry consisting of important principles, types of compounds, and methods of synthesis and analysis. Particular emphasis is given phases of the subject leading to the study of the biological sciences.

Prerequisites: Ch-102; Ch-213.

CHEMISTRY (Advanced Organic Chemistry) 3-3 Ch-322

Objective: To give a more advanced training in organic chemistry to specialized groups.

Description: Special topics in organic chemistry of particular interest to the student group are selected for advanced study.

Prerequisites: Ch-311; Ch-312.

CHEMISTRY (Organic Chemistry - High Polymers) 2-0 Ch-323

Objective: To give advanced training in organic chemistry to specialized groups.

Description: An outline of theory and practise of high polymer chemistry.

Prerequisites: None.

CHEMISTRY (Physical Chemistry) 4-4 Ch-401

Objective: To supply the prerequisite background for students who are to attend a civilian university for graduate study.

Description: An intensive study of the laws governing chemical behavior and the physico-chemical properties of matter. Solids, liquids, gases, solutions, chemical equilibria, chemical kinetics, colloid chemistry, chemical thermodynamics and atomic structures are studied. Problems illustrative of the principles studied form an integral part of the course.

The laboratory work consists of experiments designed to illustrate the principles discussed in the lectures.

Prerequisites: Ch-101 or Ch-121.

CHEMISTRY (Physical Chemistry) 2-2 Ch-411

Objective: To supply, in conjunction with Ch-412, prerequisite background for students who are to attend a civilian university for graduate study.

Description: A study of the laws governing chemical behavior and the physico-chemical properties of matter. Topics include gases, solids, liquids, solutions, chemical equilibria, thermo-chemistry, chemical thermodynamics, and chemical kinetics. Problems illustrative of the principles studied form an integral part of the course.

The laboratory work consists of experiments designed to illustrate principles discussed in the lectures.

Prerequisite: Ch-101 or Ch-121.

CHEMISTRY (Physical Chemistry) 2-2 Ch-412

Objective: To supply, in conjunction with Ch-411, prerequisite background for students who are to attend a civilian university for graduate study.

Description: A continuation of the matter presented in Ch-411.

Prerequisite: Ch-411.

CHEMISTRY (Chemical Engineering Thermodynamics) 3-2 Ch-612

Objective: To provide and apply the fundamental principles of chemical and chemical engineering thermodynamics.

Description: A continuation and extension of course Ch-611, with applications of the principles of thermodynamics to the unit operations of chemical engineering. Numerical problems form an integral part of the course.

Prerequisite: Ch-611.

THERMODYNAMICS (Chemical Thermodynamics) 3-2 Ch-613

Objective: To extend the study of thermodynamic principles to include topics in chemistry that are of concern to the mechanical engineer.

Description: The subject matter is an extension of previous studies, and includes a specialized treatment of the thermal and thermodynamic properties of materials; thermochemistry; equilibrium and the phase rule; phase relations; chemical equilibrium and energy relations, particularly at hightr temperatures and pressures. Numerical problems form an integral part of the course.

Prerequisites: Two terms of engineering thermodynamics; one term of physical chemistry.

CHEMISTRY (Thermodynamics) 3-2 Ch-631

Objective: To provide certain fundamental principles of thermodynamics that are required for the study of rocket motors, and similar applications.

Description: An abbreviated intensive course in the basic concepts of thermochemistry and chemical thermodynamics. A study of the thermal properties and energy relations of combustion products, thermodynamic properties of gases, chemical equilibria at high temperature, etc. This course supplies a prerequisite necessary for subsequent courses in rocket motors and interior ballistics. Numerical problems illustrate the basic theory and methods developed in the classroom.

Prerequisite: Ch-101 or Ch-121.

CHEMISTRY (Chemical Engineering Calculations) 3-2 Ch-701

Objective: To provide an introduction to some of the engineering methods of solution of industrial problems.

Description: Chemical calculations in both English and metric units; material balances and energy balances for combustion, evaporation, etc.; stoichiometry of the unit operations of chemical engineering.

Prerequisite: Ch-101 or Ch-121.

CHEMISTRY (Physical Chemistry) 4-2 Ch-421

Objective: To supply the background in Physical Chemistry necessary for an appreciation of applications of the subject that may be encountered in the Naval service.

Description: A study of the laws governing chemical behavior and the physico-chemical properties of matter. Topics include gases, solids, liquids, solutions, chemical equilibria, thermo-chemistry, chemical thermodynamics, and chemical kinetics. Problems illustrative of the principles studied form an integral part of the course.

The laboratory work consists of experiments designed to illustrate principles discussed in the lectures.

Prerequisite: Ch-101 or Ch-121.

CHEMISTRY (Physical Chemistry) 4-4 Ch-441

Objective: To supply the prerequisite background in theoretical chemistry for students specializing in the field of radiological defense and who will enter graduate school 1947-1948 only.

Description: The subject matter includes gases, liquids, solids, solutions, thermo-chemistry, chemical thermodynamics, colloid chemistry, chemical equilibrium and chemical kinetics.

Problems are assigned and experiments are performed which illustrate import principles.

Prerequisite: Ch-101 or Ch-102a.

CHEMISTRY (Physical Chemistry) 4-2 Ch-442

Objective: To provide an adequate background in theoretical chemistry for students specializing in the field of radiological defense and preparing for graduate studies.

Description: The course involves a study of the laws governing chemical behavior and the physico-chemical properties of matter. Some of the topics considered are gases, liquids, solids, solutions, thermo-chemistry, chemical thermodynamics, colloid chemistry, chemical equilibrium and chemical kinetics.

Problems are assigned and laboratory experiments are performed to illustrate the principles discussed in the lectures.

Prerequisites: Ch-101 or Ch-102; and Ch-213.

CHEMISTRY (Plastics) 3-2 Ch-521

Objective: To present a survey of the nature of plastics, their properties and their uses as engineering materials.

Description: The subject matter includes a study of the nature and types of plastics, their properties, applications and limitations as an engineering material. Included is a discussion of natural and synthetic rubbers.

The laboratory exercises consist of the preparation of typical plastics, a study of their physical and chemical properties, and identification tests.

Prerequisite: Ch-101 or Ch-121.

CHEMISTRY (Physical Chemistry) 2-0 Ch-531

Objective: To continue the study of physical chemistry, emphasizing certain phases of particular importance in metallurgy.

Description: The subject matter is an extension of the course in physical chemistry, covering applications of importance in the refining and production of metals. Stoichiometry of the blast furnace; law of mass action; chemical equilibria in slag and bath; effect of atmospheres. Numerical problems form an integral part of the course.

Prerequisites: Ch-401 or Mt-101; Mt-201; Mt-202.

CHEMISTRY (Reaction Motors) 2-2 Ch-541

Objective: To present an outline of the theory, design and application of reaction motors.

Description: The subject matter includes the theory and design of rocket motors and thermal jet engines, nozzles, solid and liquid propellants and the applications of these devices to military uses. Numerical problems form an integral part of the course.

Prerequisites: Me-141; and Me-142 or Ch-631.

CHEMISTRY (Radiochemistry) 3-0 Ch-551

Objective: To provide an introduction to radiochemistry and the study of chemical changes resulting from radioactivity irradiation.

Description: A seminar course with discussions on the important aspects of radioactivity from the standpoint of chemical changes which may be induced; possible health hazards associated with radioactivity; practical aspects of detection procedures; safety measures.

Prerequisite: Ch-101.

CHEMISTRY (Physical Chemistry) 3-2 Ch-561

Objective: To supply a background in physical chemistry to graduate students in mechanical engineering.

Description: A study of the laws governing chemical behavior and the physico-chemical properties of matter. The course reviews and extends the principles treated in previous chemistry courses. Particular emphasis is placed on chemical kinetics and chemical equilibria of the combustion products and basic combustion reactions. Numerical problems form an integral part of the course.

The laboratory work consists of experiments designed to illustrate certain phases of the principles discussed in the lectures.

Prerequisites: Ch-101; Ch-111 or Ch-121.

CHEMISTRY (Physical Chemistry) 3-2 Ch-571

Objective: To supply background in theoretical chemistry to aeronautical engineering students.

Description: The subject matter includes further discussion of topics such as the kinetic theory, solutions, chemical equilibria and chemical kinetics. In addition the theory and development of liquid and solid propellant feuls used in jets and rockets are considered.

The laboratory work consists of experiments designed to illustrate principles discussed in lecture.

Prerequisites: Ch-111 or Ch-121; Me-131; Me-132.

CHEMISTRY (Special Fuels) 2-2 Ch-581

Objective: To familiarize the student with some of the problems associated with special fuels.

Description: A brief survey of the organic and physical chemistry necessary for an appreciation of the problems associated with special fuels; possible future developments and limitations, and methods of reaction rate control.

Prerequisites: None.

CHEMISTRY (Chemical Engineering Thermodynamics) 3-2 Ch-611

Objective: To provide the fundamental principles of chemical and chemical engineering thermodynamics.

Description: A study of the fundamentals of thermodynamics, the concept of energy and energy transformations; thermodynamic properties of substances, ideal and non-ideal gases; thermochemistry. Numerical problems form an integral part of the course.

Prerequisite: Ch-101.

CHEMISTRY (Unit Operations of Chemical Engineering) 3-2 Ch-711

Objective: To provide an introduction to the unit operations of chemical engineering.

Description: An introduction to chemical engineering; study of the unit operations of transportation of fluids, heat transfer, and evaporation.

Prerequisite: Ch-101 or Ch-121.

CHEMISTRY (Unit Operations of Chemical Engineering) 3-2 Ch-712

Objective: To continue the study of the unit operations of chemical engineering.

Description: A continuation of course Ch-711; the study of selected unit operations such as drying, distillation, extraction, and filtration.

Prerequisite: Ch-711

CHEMISTRY (Seminar) 1-0 Ch-800

Objective: To become familiar with methods of research and organization of literature in chemistry.

Description: Subjects assigned are to be reviewed and discussed. Chemical literature is reviewed and used to prepare reports.

Prerequisites: None.

COMMUNICATIONS

Co, Ta, and GL Courses

Typing and Radio Code	Co-101
Radio Code and Procedure	Co-102
Visual and Voice Procedure	Co-103
Communication and Other Pertinent Naval Organizations	Co-104
Communication Security	Co-110
Teletypewriter; Appendices to ComInst.	Co-111
International and Commercial Communications	Co-112
Correspondence and Mail	Co-113
Crypto Systems Instruction	Co-114
Basic Naval Communication Instructions	Co-120
Communication Plans (Basic Rapid Comm. Plan)	Co-121
Communication Plans (Type and Task Force)	Co-122
Communication Plans (Amphibious and Deceptive)	Co-123
Tactics	Ta-101
Tactics	Ta-102
Tactics	Ta-103
Tactics	Ta-104
Navigation (Basic and Refresher Course)	GL-101
Celestial and Loran Navigation	GL-102

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COMMUNICATIONS (Typing and Radio Code) 0-4 Co-101

Objective: To develop a typing skill sufficient to enable the student to perform communication duties and to begin the study of radio code.

Description: This course is the first in the operating communication series. Students attaining a proficiency of 30 words per minute during the course will then be started on radio code. Students who have not reached 30 WPM (typing) by the end of the term will be examined periodically during later terms until they attain this speed.

Prerequisites: None.

COMMUNICATIONS (Radio Code and Procedure) 0-4 Co-102

Objective: To give the student a practical and thorough working knowledge of radio CW procedure and to develop the radio operating ability of the student on simulated drill or fleet circuits, in order that he may become a competent supervisor of Naval Communications.

Description: This is the second course in the operating communication series. It is a continuation of Co-101 and is designed to make the student proficient by actual operation in radio CW procedure, circuit discipline, message drafting, log keeping, message servicing, and handling all types of radio CW messages through the use of simulated drill or fleet circuits.

Prerequisite: Co-101.

COMMUNICATIONS (Visual and Voice Procedures) 0-3 Co-103

Objective: To give the student a practical and thorough working knowledge of radio voice procedure and visual methods of communications and to develop ability in sending and receiving flashing light and semaphore in order that he may become a competent supervisor of Naval Communications.

Description: This course is the third in the operating communication series. It is designed to make the student proficient by actual operation in radio voice procedure, flashing light procedure, and semaphore procedure. Transmission of general signals by these methods, which is studied in Co-120, is given practical demonstration both in Co-102 and Co-103 and the tactical practical works.

Prerequisites: Co-101; Co-102.

COMMUNICATIONS (Communication and Other Pertinent Naval Organizations) Co-104
2-1

Objective: To give the student officer a thorough grounding in the organization of the U. S. Naval Communication Service and an understanding of the principles of organization of offices, ships, staffs and Bureaus of the Navy in order to make him a more capable administrator of such an organization.

Description This course is the final one of the operational communication series. It covers the organizational problems of the communication service ashore and afloat and the latest developments. The recitation periods are devoted in part to seminar presentation of the organization and duties of communications organizations and partly to the other phases of naval organization. The practical work periods are used for lectures by competent officers from the field on the various phases of the communication service in which they are currently performing duty.

Prerequisites: None.

COMMUNICATIONS (Communication Security) 1-1 Co-110

Objective: To provide the student officer with a background of knowledge of communication security principles and registered publication handling in order to prepare him to effectively carry out this important function in his future duties.

Description: This course covers the principles of communication security and provides a knowledge of the rules of registered publication handling.

Prerequisites: None.

COMMUNICATIONS (Teletypewriter; Appendices to ComInst) 2-1 Co-111

Objective: To provide the student officer with a background knowledge of tape relay instructions and procedures and of pertinent appendices to Communication Instructions in order to prepare him to effectively carry out duties involving these subjects.

Description: This course covers tape relay procedures and instructions, handling of toll traffic, and other special instructions pertinent to functions of Communication Officers.

Prerequisites: None.

COMMUNICATIONS (International & Commercial Comm.) 1-1 Co-112

Objective: To present the student officer with a broad picture of International Communication Agreements and Services and the inter-relationship between the U.S. Naval Communication Service and the various commercial companies in order that he may have a better understanding of communications as a whole and be able to coordinate facilities when necessary.

Description: This course covers International Agreements, Frequendies and Navigational Aids. In addition it covers communications with merchant ships and communications with the Coast Guard. The operation of various commercial companies and their interrelationship with U.S. Naval Communication Service is covered.

Prerequisites: None.

COMMUNICATIONS (Correspondence and Mail) 1-0 Co-113

Objective: To give the student officers and understanding of the principles of organization of a captain's office or a flag office, the Navy filing system, and the handling of official correspondence; and an understanding of the responsibilities of the Communication Officer in regards to the U. S. Postal Service in order that he may be qualified to perform those duties of a Communication Officer, or Flag or Ship's Secretary pertaining to Naval Correspondence and office organization.

Description: This course consists of lectures and written exercises on office management, files and filing, and correspondence; with a brief summary of the duties of the shipboard Communication Officer with regards to Postal Service.

Prerequisites: None.

COMMUNICATIONS (Crypto Systems Instruction) 0-2 Co-114

Objective: To familiarize the student with the latest crypto systems and procedures to make the student competent in handling problems concerning cryptographic work which might occur in service.

Description: The student is taught the actual handling and manipulation of cryptographic aids and devices and is given sample texts to encrypt and decrypt using all effective systems. In addition, the overall crypto plan of the U. S. Navy is studied through practical works on the subject.

Prerequisite: Co-110

COMMUNICATIONS (Basic Naval Communication Instructions) 2-3 Co-120

Objective: To thoroughly cover basic naval communications with detailed study of naval radio and visual procedure and the General Signal Book in order to prepare the student for the study of Basic Rapid Communication Plan.

Description: This course is the first in the series of formal study courses concerning communications, based principally on Communication Instructions. It covers the basic doctrines and policies of naval communications afloat and ashore. It also covers detailed naval radio and visual procedure and the General Signal Book. The practical work periods are devoted to the practical application of radio and visual systems, the use of call sign books, message drafting, and the General Signal Book.

Prerequisites: None.

COMMUNICATIONS (Communication Plans (Basic Rapid Comm. Plan)) 2-2 Co-121

Objective: To commence the study of the basic rapid communication plan and the priccíples of communication planning for all types of actual naval operations in order to prepare the student officer for the study of more advanced planning.

Description: This is the second of the series of formal study courses covering communication subjects. It is based primarily on the study of the basic rapid communication plan. The practical works consist of correlating exercises involving the interpretation of simple communication plans and the preparation of simple exercise plans.

Prerequisites: Co-110; Co-120.

COMMUNICATIONS (Communication Plans (Type and Task Force)) 2-3 Co-122

Objective: To continue study of the Basic Rapid Communication Plan and its application to the typical plans of type and Task Force organizations in order to prepare the student officer for staff communication duty with those organizations.

Description: This course is a continuation of the formal study of Communication Planning. It covers the application of principles learned to the development of typical communication plans for Surface Action Force, Carrier Task Force, Escort of Convoy, and Submarine Force Operations. The practical work covers the interpretation of typical COMPLANS and the preparation of exercise plans.

Prerequisites: Co-110; Co-120; Co-121.

COMMUNICATIONS (Communication Plans - Amphibious and Deceptive) 1-3 Co-123

Objective: To complete the study of the Basic Rapid Communication Plan and its application to the typical plans of Amphibious and Deception organizations in order to prepare the student officer for staff communication duty with those organizations.

Description: This course is the final formal study of communication planning. It covers the application of principles learned to the development of typical communication plans for Amphibious and Deception Operations. The practical work covers the interpretation of COMPLANS and the preparation of exercise plans. The completion of this course realizes the objective of furnishing the student with background knowledge required to draw up or assist in drawing up a communication plan suitable to any mission assigned or derived.

Prerequisites: Co-120; Co-121; and Co-122.

TACTICS 2-2 Ta-101

Objective: To provide the student officer with a firm background knowledge of the Principles and Applications of Naval Warfare and of the General Tactical principles and procedures required to implement such warfare.

Description: By formal study of the Principles and Applications of Naval Warfare, General Tactical Instructions, and CIC Instructions, the student is prepared for the study in later terms of the procedures developed to solve the tactical problems of specific forces. The practical works emphasizedthe usefulness of the maneuvering board and CIC in the solution of such problems. They also point up the relation of communications to operations, and demonstrate the intimate relationship of general signals with tactics.

Prerequisites: None.

TACTICS 2-2 Ta-102

Objective: To acquaint the student officer with the major applications of principles studied in Co-202 to Striking Forces and their essential supporting forces.

Description: By study of Surface Action and Tactics and the Carrier Task Force Tactical Instructions the student officer learns how the principles studied in the first term are applied to the operations of the Striking Forces. By study of the Long Range Air Reconnaisance and Scouting Instructions and the Logistic Support Force Instructions he learns of the support required for large scale operations. Practical works on the game board emphasize the magnitude of tactical problems encountered by Striking Force commanders and introduce the element of timing in operations.

Prerequisite: Ta-101.

TACTICS 2-2 Ta-103

Objective: To give the student officer a basic knowledge of the application of naval tactical instructions and the principles of naval warfare to Submarine and Anti-Submarine Forces and to introduce him to Escort of Convoy procedures.

Description: This course introduces the student officer to the tactical problems of Submarine, Anti-Submarine, and Convoy Escort Commanders, and outlines the procedures developed to solve these problems.

Prerequisites: Ta-101; Ta-102.

TACTICS 2-2 Ta-104

Objective: To give the student officer a basic knowledge of the application of Naval Tactical Instructions and the principles of Naval Warfare to Amphibious Forces and to introduce him to tactical countermeasures.

Description: This course introduces the student officer to the tactical problems involved in Amphibious Operations and outlines the procedures developed to solve these problems.

Prerequisites: Ta-101; Ta-102; Ta-103.

NAVIGATION (Basic Refresher Course) 2-2 GL-101

Objective: To review and extend the student officers knowledge of the elements of navigation.

Description: This course treats the subject matter of the magnetic compass, piloting, dead reckoning, radar navigation, and the preliminary portions of celestial navigation with practical works in the use of navigational instruments, charts, and Hydrographic Office publications.

Prerequisites: None.

NAVIGATION (Celestial and Loran Navigation) 2-2 GL-102

Objective: To review and extend the student officers' knowledge of navigation.

Description: This course is a continuation of GL-101 and treats the subject matter of celestial navigation and Loran with practical works in plotting and the use of the pertinent text and reference publications.

Prerequisite: GL-101.

CRYSTALLOGRAPHY

Cr Courses

Crystallography and X-Ray Techniques	Cr-271
Crystallography and Mineralogy	Cr-301

CRYSTALLOGRAPHY AND X-RAY TECHNIQUES 3-2 Cr-271

Objective: To provide the student with the necessary background in modern crystallography and x-ray methods, in order that he may efficiently carry on graduate work at a civilian university.

Description: The student is first introduced to the fundamental concepts of crystallography, including: symmetry, point groups, plane lattices, space lattices, space groups, coordinate systems, indices, crystal classes, crystal systems, common forms and combinations in the various systems. The stereographic projection is then studied.

With this foundation, some time is spent on a discussion of the crystal structure of the elements, metals, alloys, and inorganic compounds.

The latter part of the course is devoted to acquainting the student with modern x-ray diffraction and radiographic apparatus and techniques, including: the theory of x-ray diffraction, the Bragg equation, powder methods, single crystal and moving film methods, high temperature diffraction technique as applied to obtaining phase diagrams, back reflection and transmitted beam methods, and practical applications of these methods.

The laboratory work includes: a study of crystal models for symmetry, forms, and combinations; the construction of stereographic projections; and actual practice in the making and interpreting of x-ray diffraction photographs.

Prerequisite: Ch-101.

CRYSTALLOGRAPHY AND MINERALOGY 3-4 Cr-301

Objective: To give the student an adequate knowledge of crystallography and mineralogy in order that he may have the necessary background for graduate studies in petroleum engineering at a civilian university.

Description: The student is first introduced to the fundamental concepts of crystallography including: symmetry; point groups; plane lattices; space lattices; space groups; coordinate systems; indices; crystal classes; crystal systems; common forms and combinations in the various systems and classes. The stereographic projection is then studied with special reference to its application to crystallographic problems.

The remainder of the time is spent on the description of some fifty of the more common minerals.

The laboratory work includes a study of crystal models for symmetry forms, and combinations; the practical application and construction of stereographic projections; and as time permits, a start is made in the identification of minerals.

Prerequisites: Ch-101 or Ch-121.

ELECTRICAL ENGINEERING

EE Courses

Fundamentals of Electrical Engineering	EE-111
DC Circuits and Fields	EE-151
Electric Circuits and Fields	EE-171
AC Circuits and Transformers	EE-214
DC Machines and AC Circuits	EE-231
AC Circuits	EE-251
AC Circuits	EE-271
AC Circuits	EE-272
AC and DC Machinery	EE-314
DC Machinery	EE-351
DC Machinery	EE-371
Transformers and Synchros	EE-451
AC Machinery - Polyphase Transformers, Synchronous Machines and Induction Motors	EE-452
AC Machinery - Transformer and Asynchronous Machines	EE-471
AC Machinery - Synchronous Machines	EE-472
Synchros	EE-473
AC Machinery	EE-491
AC Machines and Long Lines	EE-492
Transmission Lines and Filters	EE-551
Transmission Lines and Filters	EE-571
Lines, Filters, Transients	EE-591
Transients and Servos	EE-651
Filters and Transients	EE-655
Transients	EE-671
Servo-Mechanisms	EE-672
Electronics	EE-711
Power Electronics	EE-731

Electronics	EE-751
Electronics	EE-753
Electronic Control and Measurement	EE-755
Electronics	EE-771
Electronics	EE-772
Power Electronics and Synchros	EE-791
Power Electronics	EE-792
Electrical Machine Design	EE-871
Electrical Machine Design	EE-872
Electrical Machine Design	EE-873
Seminar	EE-971
Thesis	EE-972

ELECTRICAL ENGINEERING (Fundamentals of Electrical Engineering) 3-2 EE-111

Objective: To impart the fundamental principles of electric and magnetic circuits necessary as a foundation for further study.

Description: This course presents a basic treatment of the general theory of electric and magnetic circuits. Electric units, Ohm's Law, and Kirchoff's laws are studied in detail. The magnetic field and the magnetic properties of iron and steel are included.

Prerequisites: None.

ELECTRICAL ENGINEERING (DC Circuits and Fields) 3-4 EE-151

Objective: To impart the fundamentals of electric circuits and fields necessary as a preparation for further study of electrical engineering.

Description: This course provides a thorough foundation in electricity and magnetism with the major emphasis on electric and magnetic circuits. The basic laws are given and many problems and laboratory experiments are assigned to illustrate the theory.

Prerequisites: None.

ELECTRICAL ENGINEERING (Electric Circuits and Fields) 3-4 EE-171

Objective: To impart the fundamentals of electric and magnetic circuits, and of electric and magnetic fields nesessary as a preparation for further study.

Description: This course gives a thorough foundation in electricity and magnetism. The basic laws are given in detail. Many problems are assigned and laboratory experiments are performed to illustrate the classroom theory.

Prerequisites: None.

ELECTRICAL ENGINEERING (AC Circuits and Transformers) 3-4 EE-214

Objective: To present a short course in alternating current circuit and transformer theory covering the essential principles needed by those groups which do not require the more advanced work in electrical engineering.

Description: The course covers as thoroughly as time will permit, single phase series and parallel circuits, resonance, vector representation and vector algebra, alternating current instruments and balanced polyphase circuits. Transformer principles, operating characteristics and connections are emphasized. Laboratory and problem work illustrate the principles studied in the classroom.

Prerequisite: EE-111.

ELECTRICAL ENGINEERING (DC Machines and AC Circuits) 3-2 EE-231

Objective: To impart the basic knowledge of direct current machines and control devices and of the alternating current circuit necessary as a foundation for further study.

Description: This course presents the general principles of DC machines both motors and generators, and of their control and application. The qualitative characteristics of the various types of motors and generators are developed from basic principles. Time is spent in a study of the DC machine, a study of the theory of alternating currents is begun. The laboratory periods are devoted to experiments to demonstrate the general machine characteristics and the use of control devices.

Prerequisite: EE-111.

ELECTRICAL ENGINEERING (Alternating Current Circuits) 3-4 EE-251

Objective: To present the essential theory of alternating current circuits for those groups that do not require the more extensive coverage given in EE-271 and EE-272.

Description: The course covers as thoroughly as time will permit, single phase series and parallel circuits, resonance, vector representation and vector algebra, the most extensively used network theorems, non-sinusoidal wave analysis, coupled circuits, and balanced polyphase circuits. Laboratory and problem work illustrate the basic principles studied in the classroom.

Prerequisite: EE-151.

ELECTRICAL ENGINEERING (Alternating Current Circuits) 3-2 EE-271

Objective: To present a thorough course in the basic theory of alternating current circuits for those technical groups requiring such preparation for further advanced study in electrical engineering.

Description: The basic theory of the alternating current circuit is developed from fundamental physical principles. This first course covers single phase series and parallel circuits, resonance, vector representation and vector algebra, the more commonly used network theorems, non-sinusoidal wave analysis, and balanced polyphase circuits, including power measurement in polyphase circuits. Laboratory and problem work illustrate the basic principles studied in the classroom.

Prerequisite: EE-171.

ELECTRICAL ENGINEERING (Alternating Current Circuits) 2-2 EE-272

Objective: To extend the knowledge of alternating current circuit theory gained in EE-271 for those technical groups requiring a thorough background for more advanced work in electrical engineering.

Description: This second course in alternating current circuit theory is a continuation of EE-271. Unbalanced polyphase circuits, additional network theorems, instruments and measurements, coupled circuits, bridge theory and symmetrical components are emphasized. Problem and laboratory work illustrate the basic principles studied in the classroom.

Prerequisite: EE-271.

ELECTRICAL ENGINEERING (Alternating and Direct Current Machinery) 3-4 EE-314

Objective: To present a short course in electrical machinery for non-technical groups and for those technical groups which do not take the more advanced work in electrical engineering.

Description: A brief study of the conventional direct current motor and generator construction, control and operating characteristics. Basic operating principles, constructional features and operating characteristics of alternators, synchronous motors, three phase induction motors, single phase induction motors and synchros are emphasized. Laboratory and problem work illustrate the principles studied in the classroom.

Prerequisite: EE-214.

ELECTRICAL ENGINEERING (DC Machinery) 2-2 EE-351

Objective: To cover the fundamentals of direct current machinery and control devices, necessary for the care and operation of naval electrical machinery.

Description: This course covers the fundamentals of DC machinery with the emphasis on operating characteristics and applications.

Prerequisite: EE-151 or EE-171.

ELECTRICAL ENGINEERING (DC Machinery) 3-2 EE-371

Objective: To impart a basic quantitative and qualitative understanding of direct current machines and control devices, necessary for further study.

Description: This course is designed to present a thorough coverage of direct current machines and their applications. The external characteristics are developed from basic relations. Problems and laboratory work supplement the classroom work.

Prerequisite: EE-171.

ELECTRICAL ENGINEERING (AC Machinery - Transformers and Synchros) 2-2 EE-451

Objective: To present a course on the principles and operating characteristics of transformers and synchros for those groups which do not require the more extensive treatment of these topics as given in courses EE-471 and EE-473.

Description: A detailed study is made of single phase transformer principles and operating characteristics including the auto-transformer, constant current transformer and other special transformers. Single phase and polyphase synchro constructional features, operating principles and characteristics are also emphasized. A comprehensive analysis is made of the voltage, current and torque relationships for regular and fault conditions. Laboratory and problem work illustrate the basic principles studied in the classroom.

Prerequisite: EE-251.

ELECTRICAL ENGINEERING (AC Machinery - Polyphase Transformers, Synchronous Machines & Induction Motors) 3-4 EE-452

Objective: To present a somewhat abbreviated alternating current machinery course for those technical groups not requiring the more extensive treatment given by EE-471 and EE-472.

Description: Polyphase transformer connections, alternators, synchronous motors, single and polyphase induction motors are emphasized. Induction generators, frequency changers, induction regulators and commutator type AC motors are studied as thoroughly as time will permit. Laboratory and problem work illustrate the basic principles studied in the classroom.

Prerequisite: EE-451.

ELECTRICAL ENGINEERING (Transformer and Asynchronous Machines) 3-4 EE-471

Objective: To present a thorough course covering the principles and operating characteristics of transformers and asynchronous machines for those technical groups requiring advanced electrical engineering work.

Description: A detailed study is made of the principles, operating characteristics and connections of single and polyphase transformers including autotransformers, constant current and other special transformers. Polyphase induction motor principles; including armature windings, voltage and mmf waves and operating characteristics are emphasized. Induction generators, induction regulators, single phase induction motors and commutator type AC motors are studied as extensively as time will permit. Laboratory and problem work illustrate the basic principles studied in the classroom.

Prerequisites: EE-271; EE-272.

ELECTRICAL ENGINEERING (AC Machinery - Synchronous Machines) 3-4 EE-472

Objective: To present a thorough course in the principles of synchronous machines and their operating characteristics for those technical groups requiring advanced electrical engineering work.

Description: Alternator and synchronous motor characteristics are studied on the basis of cylindrical rotor and two reaction theories. Armature windings, voltage and mmf waves, armature reaction, load saturation curves, regulation, losses and efficiency for synchronous machines are emphasized. Parallel operation of alternators, synchronous frequency changers, and synchronous converters are studied in detail. Laboratory and problem work illustrate the basic principles studied in the classroom.

Prerequisites: EE-271; EE-272.

ELECTRICAL ENGINEERING (Synchros) 2-2 EE-473

Objective: To present a thorough course in the basic theory of synchros and synchro systems for those technical students requiring preparation for further advanced study.

Description: The mathematical treatment of single and polyphase synchro systems covers voltage, current and torque relations for normal and fault conditions, vector diagrams and equivalent circuits. Problems and laboratory work illustrate the basic theory.

Prerequisites: EE-171; EE-271; EE-272.

ELECTRICAL ENGINEERING (Lines, Filters, Transients) 3-2 EE-591

Objective: To impart the fundamentals of circuits containing distributed constants, of electric transients, and of filters necessary for further work and for the operation and care of naval electrical machinery.

Description: This course is a continuation of that of the previous term. The theory of circuits containing distributed constants is completed. Then the subject of electric tansients is begun. The classical and the operational methods of solution are used for various series, parallel, and coupled circuits. Later the theory of electric filters is presented. Many problems are assigned.

Prerequisites: EE-191; EE-391; EE-291; EE-292; EE-491; EE-492.

ELECTRICAL ENGINEERING (Transients and Servos) 3-4 EE-651

Objective: To present the essential basic principles of transients and servomechanisms for technical students.

Description: Topics covered are DC and AC transients in series, parallel, series-parallel and coupled circuits using the methods of differential equations and Heaviside. The La Place transform method is introduced. Analysis of servomechanisms with viscous damping, differential and integral control. Transfer function method of analysis of servo-mechanisms. Problems and laboratory illustrate the basic principles.

Prerequisite: EE-451.

ELECTRICAL ENGINEERING (Filters and Transients) 3-2 EE-655

Objective: To present the essential basic principles of filters and transients for technical students.

Description: Topics covered are T and π sections, constant k filters, m derived filters, DC and AC transients in series, parallel, series parallel and coupled circuits using the methods of differential equations and Heaviside. The La Place method is introduced.

Prerequisite: EE-251.

ELECTRICAL ENGINEERING (Transients) 3-4 EE-671

Objective: To present a thorough course in the basic theory of transients in electrical networks, for those technical students requiring preparation for further advanced study.

Description: Topics covered are DC and AC transients in series, parallel, series-parallel and coupled circuits, particular boundary conditions using the methods of differential equations, Heaviside, Fourier and La Place. Non-linear circuits are also studied. Other forcing functions besides DC and AC are studied. Problems illustrate the basic theory and methods of analysis.

Prerequisites: EE-251 or EE-272; Ma-106.

ELECTRICAL ENGINEERING (Alternating Current Machinery) 3-4 EE-491

Objective: To impart the fundamental theory of alternating current machinery and of control and applications, necessary for further work and for the operation and care of naval electrical machinery.

Description: This course is planned to give a thorough knowledge of the theory and performance of the synchronous machine, both generator and motor, and of the polyphase induction motor. The operating characteristics are developed from basic relations. The factors upon which design depends are emphasized. Many problems are assigned to illustrate the theory. Laboratory work parallels that of the classroom.

Prerequisites: EE-191; EE-391; EE-291; EE-292.

ELECTRICAL ENGINEERING (AC Machines and Long Lines) 3-4 EE-492

Objective: To impart the fundamental theory of alternating current machinery, of control and applications, and of circuits containing distributed constants, necessary for further work and for the operation and care of naval electrical machinery.

Description: This course is a continuation of that of the previous term. It presents a thorough knowledge of rotary converters, induction generators and single phase motors. The application of machines to the electric drive is treated in detail. Later in the course circuits containing distributed constants are presented. Heaviside's relations are developed and extended to particular conditions. Problems are assigned to illustrate basic facts. Laboratory work parallels the work of the classroom.

Prerequisites: EE-191; EE-391; EE-291; EE-292; EE-491.

ELECTRICAL ENGINEERING (Transmission Lines and Filters) 3-2 EE-551

Objective: To present the essential basic principles of transmission lines and filters for technical students.

Description: Topics covered are transmission line parameters, infinite line, open and shorted lines, reflection, matching, stubs, T and π sections, constant k filters and m derived filters. Problems and laboratory work illustrate the basic principles.

Prerequisites: EE-151; EE-251.

ELECTRICAL ENGINEERING (Transmission Lines and Filters) 3-4 EE-571

Objective: To present a thorough course in the basic theory of transmission lines and filters for those technical students requiring preparation for further advanced study.

Description: Topics covered are transmission line parameters, infinite line, open and shorted lines, reflection, transmission line efficiency, impedance transformation, stubs, T and π sections, constant k filters, m derived and composite filters. Problems and laboratory work illustrate the basic theory.

Prerequisites: EE-171; EE-271; EE-272.

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ELECTRICAL ENGINEERING (Servo-Mechanisms) 3-4 EE-672

Objective: To present a thorough course in the basic theory of servo-mechanisms for those technical students requiring preparation for further advanced study.

Description: Topics covered are elementary forms of control systems, servo system follow-up links, analysis of servo-mechanisms with viscous damping, error rate damping, integral control, transfer function and db-log freq analysis methods, error rate stabilization networks and typical design calculations and general considerations. Problems and laboratory illustrate the basic theory and methods of analysis.

Prerequisites: EE-671; EE-452 or EE-473.

ELECTRICAL ENGINEERING (Electronics) 3-2 EE-711

Objective: To present a fundamental study of the basic theory of electron tubes and circuits for non-technical students.

Description: The course consists of a study of the fundamental theory of the electron, gaseous conduction, thermionic emmission, and electron tube characteristics. The principles of amplifier, rectifier, and oscillator circuits are presented in their essentials. Some time is devoted to the study of special tubes encountered in electronic devices. Laboratory work serves to integrate the principles presented in the classroom with practical applications and circuits.

Prerequisites: EE-111; EE-214.

ELECTRICAL ENGINEERING (Power Electronics) 3-2 EE-731

Objective: To impart the theory of electronics and synchro units and to study their application to naval devices.

Description: The course gives a knowledge of the theory and application of the various types of electron tubes. Emphasis is placed upon the thyratron tube. In addition the theory of selsyn instruments and their use is presented. The laboratory work consists of experiments performed with the various electron tubes and selsyns. Remote control is demonstrated with laboratory models.

Prerequisites: EE-111; EE-231.

ELECTRICAL ENGINEERING (Electronics) 3-4 EE-751

Objective: To present the essential basic principles of electron tubes and circuits for technical students.

Description: The course consists of a study of electron tube characteristics and the basic circuits in which tubes are used. The theory and application of vacuum and gas tubes is covered including such special tubes as the ignitron, cathode ray tube, and phototube. The basic theory of rectifier and amplifier circuits is developed and illustrated in actual commercial applications. Problem and laboratory work is designed to illustrate the classroom presentation.

Prerequisite: EE-451.

ELECTRICAL ENGINEERING (Electronics) 1-2 EE-753

Objective: To present the basic principles of industrial electronic circuits for technical students.

Description: The course consists of a study of the operating principles of electronic power and control circuits with particular attention to the application of gas and vapor tubes. The fundamentals of amplifiers and oscillators will be covered as necessary for the study of control circuits in commercial applications. Laboratory and problem work will illustrate the principles presented in the classroom.

Prerequisite: EE-451.

ELECTRICAL ENGINEERING (Electronic Control and Measurement) 3-4 EE-755

Objective: To impart a knowledge of the principles and practice of electronic control and measurement as used in research laboratories and industry.

Description: The course includes a study of the theory of basic circuits such as vacuum tube voltmeters, bridges, direct coupled amplifiers, timing circuits and frequency sensitive circuits with particular attention to their application in industrial imstruments for measurement and control of current, voltage, frequency, illuminators, speed, pressure and temperature.

Prerequisite: EE-751.

ELECTRICAL ENGINEERING (Electronics) 3-2 EE-771

Objective: To present a thorough study of the theory of electronic tubes and the circuits in which they are used for the technical groups requiring such preparation for advanced study in electrical engineering.

Description: The course consists of a study of electron motion in electric or magnetic fields, vacuum and gas tube characteristics including such special tubes as the ignitron, glow tube, cathode ray tube, and phototubes. Circuit theory of rectifiers, detectors, amplifiers, and oscillators is covered with particular attention given to industrial power and control applications. Laboratory and problem work illustrates the principles covered in the classroom.

Prerequisites: EE-171; EE-271; EE-272.

ELECTRICAL ENGINEERING (Electronics) 2-2 EE-772

Objective: To continue the study of industrial electronic power and control applications for technical groups requiring such preparation for advanced study in electrical engineering.

Description: The more complicated electronic circuits encountered in practice are studied in detail with particular attention given to the integration of various components in accordance with basic theory of stabilization and feedback.

Prerequisite: EE-271.

ELECTRICAL ENGINEERING (Power Electronics and Synchros) 3-2 EE-791

Objective: To impart the fundamental theory of synchro instruments and their applications, and of electronics, necessary for further work and for the care and operation of naval electrical devices.

Description: This course presents a thorough analysis of the synchro instrument for normal and fault conditions. The relations are developed mathematically for static and dynamic operation. Later a thorough presentation is given of the basic phenomena of electronics. The physical theory is emphasized. Prob- are assigned. Work in the laboratory supplements the work of the classroom.

Prerequisites: EE-191; EE-391; EE-291; EE-292; EE-491; EE-492; EE-591.

ELECTRICAL ENGINEERING (Power Electronics) 3-2 EE-792

Objective: To impart a broad knowledge of electronics and applications, part-icularly to remote control, necessary for the care and operation of naval electrical devices.

Description: This course is a continuation of that of the previous term. It presents a thorough treatment of the characteristics of electron tubes under dynamic conditions and their applications. Remote control is emphasized. Many problems are assigned. The laboratory work illustrates and supplements that of the classroom.

Prerequisites: EE-191; EE-391; EE-291; EE-292; EE-491; EE-492; EE-591; EE-791.

ELECTRICAL ENGINEERING (Electrical Machine Design) 4-0 EE-871

Objective: To impart a thorough quantitative knowledge of machine character-istics using the design approach. Though it is not the intention to develop a facility in design, the aim of this course and the two that follow is to develop an appreciation of the quantitative limitations and possibilities in electrical machine construction especially for naval applications. To develop the ability to evaluate properly the possible merits and limitations for naval use of the designs of others is the chief objective.

Description: This course consists of a quantitative study of the transformer and the design of the electrical features of a particular transformer. Each student is given a certain transformer to design and analyze. Later the analysis of a direct current generator is begun.

Prerequisites: EE-191; EE-391; EE-291; EE-292; EE-491; EE-492.

ELECTRICAL ENGINEERING (Electrical Machine Design, II) 4-0 EE-872

Objective: The objective is that of course EE-871 that precedes.

Description: This course consists of the completion of the quantitative study and design of the direct current generator and the beginning of a similar study and design of the synchronous machine.

Prerequisites: EE-191; EE-391; EE-291; EE-292; EE-491; EE-492; EE-871.

ELECTRICAL ENGINEERING (Electrical Machine Design, III) 4-0 EE-873

Objective: The objective is the same as that of EE-871 and EE-872.

Description: This course consists of the completion of the quantitative study and design of the synchronous machine and a similar study and design of the induction machine.

Prerequisites: EE-191; EE-391; EE-291; EE-292; EE-491; EE-492; EE-871; EE-872.

ELECTRICAL ENGINEERING (Seminar) 1-0 EE-971

Objective: To present to the more advanced groups of student officers, papers on research and development in the field of electrical science and to furnish some appreciation of research methods.

Description: At the seminar sessions papers treating of research in progress and of developments of major importance in electrical engineering are presented and discussed by the electrical engineering faculty and by the more advanced student officers.

ELECTRICAL ENGINEERING (Thesis) EE-972

Objective: To provide an opportunity for research and study necessary for the preparation of the thesis as required for the Master's Degree in Electrical Engineering.

Description: Individual laboratory and library work is performed under the general supervision of the members of the electrical engineering staff.

Prerequisites: The first two years of the advanced electrical engineering curriculum.

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Thesis	Es-832
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Introduction to Electronics	Es-991
Introduction to Electronics	Es-992

ELECTRONICS (Electronics Administration) 2-0 Es-036

Objective: To acquaint the student with the organization and administration of electronics facilities, afloat and ashore.

Description: The following topics are included: Navy Department organization; naval shipyard procedures; the Civil Service; duties of electronics officer, afloat and ashore; radio station administration; material procurement, accounting, and disposal; general problems involved in communication station design.

Prerequisites: None.

ELECTRONICS ENGINEERING (Electricity) 4-4 Es-111

Objective: To develop fundamental D.C. circuit principles in support of current and future electrical and electronics courses.

Description: This course is laid out to develop a sound conception of electromotive force, potential, resistance, current; a facility in the use of such basic principles as Ohm's law, Kirchhoff's laws, series, parallel, and series parallel circuits; the theory and use of D.C. instruments and bridges, the magnetic circuit, and an introduction to A.C. principles. Simple D.C. transients in RL and RC circuits will be treated.

The laboratory will strive, by simple experiments, to make clear the fundamental concepts studied in class; it will acquaint the students with typical circuit elements and simple measuring devices and their proper uses.

Prerequisites: None.

ELECTRONICS ENGINEERING (Electricity) 4-3 Es-112

Objective: To develop fundamental A.C. circuit principles in support of current and future electronics courses.

Description: This course will continue to develop sound conceptions of A.C. circuit principles, reactance, impedance, admittance, conductance, susceptance; it will introduce network theorems, series and parallel circuits and complex notation; the theory and use of A.C. instruments and bridges and the influence upon them of frequency, wave form and impedance. Resonant and coupled circuits will be included.

The laboratory will illustrate the principles studied in class, exercise the students in the application of these principles and develop simple laboratory techniques.

Prerequisite: Es-111.

ELECTRONICS ENGINEERING (Circuit Analysis and Measurements) 3-3 Es-113

Objective: To acquaint the student with the fundamentals of radio circuit analysis and radio measurements in preparation for more advanced radio engineering circuit theory.

Description: Subjects included are: Coupled circuits, the infinite line, high frequency bridges.

Prerequisite: Es-112.

ELECTRONICS ENGINEERING (Circuit Analysis and Measurements) 3-3 Es-114

Objective: To continue the objective of Es-113.

Description: Subjects included are: Reflections, stubs, use of circle diagrams, constant k, and m-derived filters, impedance transformations.

Prerequisite: Es-113.

ELECTRONICS ENGINEERING (Advanced Circuit Theory) 3-2 Es-121

Objective: To acquaint the student with the analysis of networks with lumped constants.

Description: Introduction to transient phenomena in electrical networks and their solutions on the loop and nodal bases. The Fourier Integral and Laplace Transform will be employed in these solutions.

Prerequisite: Es-114.

ELECTRONICS ENGINEERING (Advanced Circuit Theory) 3-2 Es-122

Objective: To continue the analysis of networks with lumped constants and extend it to those with distributed constants.

Description: The Laplace method will be applied to the analysis of typical circuits used in radio and radar.

Prerequisite: Es-121.

ELECTRONIC ENGINEERING (Radio Frequency Measurements) 2-6 Es-126

Objective: To acquaint the student with the techniques of measurements at high frequencies.

Description: A study of bridges, resonant circuits, transmission lines, slotted lines and other methods of measurements at high frequencies; standards of E, R, L, and C; measurement of power and frequency.

Prerequisite: Es-114.

ELECTRONICS ENGINEERING (Advanced Circuit Theory) 3-0 Es-133

Objective: To present a thorough treatment of the transmission line as a communication facility, leading to filter theory.

Description: The following subjects are studied: Four terminal networks, Foster's reactance theorem with Cauer's extension, Lagrange's equations, driving point impedance, principle of duality, lumped loaded lines, lattice structures.

Prerequisite: Es-122.

ELECTRONICS ENGINEERING (Advanced Circuit Theory) 3-0 Es-134

Objective: To continue treatment of the transmission line as a communication facility emphasizing filter theory.

Description: The theory and basic design of ladder and lattice structure filters are studied together with their transient behavior.

Prerequisite: Es-133.

ELECTRONICS ENGINEERING (Communications Fundamentals) 4-4 Es-186

Objective: To present the fundamental principles of radio communication and begin the consideration of basic communications circuits.

Description: The following topics are included; fundamentals of energy transmission by means of radio waves; radio circuit elements; circuits for voltage division and separation; frequency selectivity circuits; coupled circuits.

Prerequisites: None.

ELECTRONICS ENGINEERING (Electron Tubes) 2-3 Es-211

Objective: This course, being the first of a sequence of five courses, begins the study of fundamental principles and application of electron tubes.

Description: The following are the main topics covered: thermionic emission, space charge, triodes, tetrodes, pentrodes, cathrode-ray tubes and oscilloscope, gas tubes, thyratrons, singe and polyphase rectifiers, power filters, regulated power supplies.

Prerequisites: None.

ELECTRONICS ENGINEERING (Electron Tubes) 2-3 Es-212

Objective: To continue the objective of Es-211 with emphasis on the applications of the tube as a switch.

Description: The following are the main topics covered: Timing, sweep and pulse circuits; audio and wide-band voltage amplifiers, square wave generator and square wave testing, clippers, clamping, differentiators and integrators, switching and keying trigger circuits and multivibrators, oscilloscope circuits.

Prerequisite: Es-211.

ELECTRONICS ENGINEERING (Electron Tubes) 4-3 Es-213

Objective: To continue the study of amplifiers.

Description: The following main topics are covered: power amplifiers of all classes, transformer coupled voltage amplifier, phase inverters, inverse feedback, cathode follower, R.F., I.F., and wide-band tuned amplifiers.

Prerequisite: Es-212.

ELECTRONICS ENGINEERING (Electron Tubes) 4-3 Es-214

Objective: To study oscillators, modulation and detection.

Description: The following main topics are covered: Feedback oscillators, crystal oscillators, B.F., R-C, and relaxation oscillators; A.M., F.M., and P.M., methods of modulation; diode, square-law, grid, and plate detection, A.V.C., infinite impedance detector, discriminators; receiver principles, and measurements.

Prerequisite: Es-213.

ELECTRONICS ENGINEERING (Electron Tubes) 3-6 Es-225

Objective: To study fields and electron motions in vacuum tubes at a graduate level.

Description: The following main topics are covered: Noise, potential fields, electron motion, electrostatic and magnetic electron optics, cathode--ray tubes, photo-multiplier, television tubes, electron microscope.

Prerequisite: Es-214.

ELECTRONICS ENGINEERING (Ultra-High Frequency Tubes) 4-3 Es-226

Objective: To acquaint the student with the principles of ultra-high frequency vacuum tubes and associated circuits.

Description: Theory and application of vacuum tubes at UHF; transit time effects; electron ballistics; Klystron and Magnetron oscillators; pulsing circuits; related laboratory work.

Prerequisites: Es-225, Es-623.

ELECTRONICS ENGINEERING (Electron Tubes and Circuits) 3-2 Es-261

Objective: To introduce the student to the fundamental principles and general applications of electron tubes leading primarily to applications in electronic control equipment.

Description: Thermionic emission; characteristics of vacuum and gas-filled tubes; rectifiers and smoothing filters; voltage stabilizers; class A amplifiers; input admittance.

Prerequisites: EE-151, EE-251.

ELECTRONICS ENGINEERING (Electron Tubes and Circuits) 3-2 Es-262

Objective: To continue the objective of Es-261.

Description: R-C coupled amplifiers; feedback amplifiers; push-pull amplifiers; tuned r-f amplifiers; modulation; detection; oscillators.

Prerequisite: Es-261.

ELECTRONICS ENGINEERING (Electron Tubes and Circuits) 3-2 Es-263

Objective: To continue the objective of Es-262.

Description: Oscillators; timing circuits; antennas; communication systems, magnetrons; velocity-modulated tubes; waveguide circuits; high-frequency measurements.

Prerequisite: Es-262.

ELECTRONICS ENGINEERING (Electronic Fundamentals) 2-2 Es-281

Objective: To acquaint the students with the basic principles of electronics.

Description: The course includes a coverage of the underlying physical principles of electron tube operation, together with a review of the mathematical tools required for the analysis of electron tube circuits.

Prerequisites: None.

ELECTRONICS ENGINEERING (Vacuum Tube Circuits) 4-4 Es-282

Objective: To continue the objective of Es-281.

Description: The following topics are included: amplitude modulation-nature and types of AM signals, types of modulation systems; demodulation n-diode detectors, other detector types, heterodyning of signals-theory, methods, applications: power sources-recrifier circuits, voltage regulator tubes; the AM transmitter and receiver-general electrical features, circuit details of typical Navy equipment; frequency modulation principles, techniques, applications.

Prerequisite: Es-281.

ELECTRONICS ENGINEERING (Pulsing and High Frequency Circuits) 2-4 Es-286

Objective: To acquaint the student with the theoretical and practical principles of circuits used in pulse modulated transmitter systems.

Description: Theory of operation and features of radar timing circuits, indicators, r-f systems, transmitters and receivers; as an introduction to further study of radar.

Prerequisite: Es-282.

ELECTRONICS ENGINEERING (Radio Systems) 3-3 Es-321

Objective: This is the first of a sequence of four courses on the engineering applications of theoretical electronics to the specific problems of radio communications. These courses are designed to give the student experience in design as well as to integrate his previous theoretical training as applied in radio systems engineering.

Description: The course will start with a survey of the basic problems of a communications system of any type with emphasis on systems involving telegraph and telephone. These basic principles are then applied to radio communications proper, with an examination of the characteristics of the transmitting medium, and natural division of the types of communications for different frequency bands. The remainder of the course is to be devoted to the design of transmitters for high and medium frequency bands. Oscillators, stability and flexibility of master oscillators, crystal oscillators, frequency synthesis generators, buffer amplifiers and multipliers, Class C power amplifiers, band switching circuits, out-put coupling circuits, speech amplifier circuits, modulators, speech clipping and AMC circuits, power supply circuits, protective circuits, control circuits.

Prerequisite: Es-225.

ELECTRONICS ENGINEERING (Radio Systems) 3-3 Es-322

Objective: To continue the series begun with Es-321.

Description: Design of receivers for high and medium frequency bands. Antenna coupling circuits, RF amplifiers, oscillators, mixers, tracking problems, I.F. amplifiers, crystal filters, detectors, noise limiters, silencers, audio amplifiers, audio filters, noise characteristics, receiver standards and testing. The operation of receivers and transmitters in communication practice; mutual interference and cross talk; spurious responses. Design of receivers and transmitters for VHF; line controlled oscillators and amplifiers; transit time loading effects; importance of noise; broad band amplifier design; narrow band FM.

Prerequisite: Es-321.

ELECTRONICS ENGINEERING (Radio Systems) 2-3 Es-333

Objective: A continuation of the series starting with Es-321.

Description: The material to be covered by this course will consist of the following subjects: teletype, frequency shift-keying applied to radio teletype, design of frequency shift transmitters, design of frequency shift receivers, basic principles of multiplexing teletype and telegraph signals with voice channel audio tones, applications of multiplexing to shore station remote control equipment, single side band transmission theory, single sideband multiplex transmitter and receiver design.

Prerequisite: Es-322.

ELECTRONICS ENGINEERING (Transmitters and Receivers) 3-3 Es-386

Objective: To acquaint the student with the electrical and operational features of Navy type receivers and transmitters.

Description: The course includes the study of representative Navy transmitters and receivers, and consideration of the practical problems involved in the operation and maintenance of Navy communication systems. The theoretical principles studied in previous courses are applied to the solution of these problems.

Prerequisites: Es-283, Es-786.

ELECTRONICS ENGINEERING (Radar) 3-3 Es-431

Objective: To study characteristic radar circuits and the design problems relating to such circuits.

Description: Fundamental principles of radar. Theory of operation and design features of radar timing circuits, indicators, RF systems, transmitters, and receivers. Related laboratory work given concurrently.

Prerequisite: Es-226.

ELECTRONICS ENGINEERING (Radar Systems) 3-6 Es-432

Objective: To study representative radar systems and the design problems relating to such systems.

Description: Study of representative search and fire-control systems, including airborne, with particular attention to design features. Study of current radar developments. Related laboratory work on current Navy radar equipment.

Prerequisite: Es-431.

ELECTRONICS ENGINEERING (Introduction to Radar) 2-2 Es-441

Objective: To acquaint the student with the operational characteristics of current fire control radar systems.

Description: A study of the radar range equation, i.e. Effect of pulse duration, pulse repetion frequency, types of targets, etc. Block diagram studies of current firecontrol systems, with emphasis on operational limitations, propagation phenomena, types of presentation, and anti-jam techniques. Laboratory: Operational techniques of current fire control systems.

Prerequisites: None.

ELECTRONICS ENGINEERING (Special Systems) 3-3 Es-531

Objective: A continuation of the series starting with Es-321.

Description: The course will consist of the following topics: Pulse time modulation, pulse time modulation multiplex, principles of television, television receiver design, television transmitter design, principles of facsimile, telemetering.

Prerequisite: Es-333.

ELECTRONICS ENGINEERING (Special Systems) 3-3 Es-532

Objective: To give the student a theoretical background to meet the problems encountered in the utilization of Loran and D.F. equipment.

Description: An analytical treatment of the fundamentals of the Loran system; an element by element analysis of the circuits of typical equipments; an analytical treatment of the directive properties of loop antennas; circuit analysis of typical radio compasses; mathematical analysis of D.F. errors; laboratory study of standard Navy Loran and D.F. equipments.

Prerequisites: Es-624, Es-431, Es-531.

ELECTRONICS ENGINEERING (Special Systems) 3-3 Es-586

Objective: To acquaint the student with the electrical and operational features of Navy type radar, loran, and special communications systems.

Description: The following topics are included: Pulse modulation systems - radar and loran; frequency-shift-keying and teletype systems; facsimile; single-side-band and multiplex systems.

Prerequisites: Es-283, Es-286.

ELECTRONICS ENGINEERING (Electromagnetics) 3-0 Es-621

Objective: To give the student a sufficient background in electromagnetic theory and practice to permit him to understand and to solve problems arising in modern radio and microwave theory.

Description: Wave mathematics; complex power; differential equation solution of transmission lines; applications of vector analysis to electrostatics and magnetostatics; Coulomb's law; Ampere's laws; gradient divergence, curl of electromagnetic fields; scalar potential; vector magnetic potential; generalized coordinates; complex variables applied to potential theory; energy stored in electromagnetic fields; Bessel equations applied to potential theory; spherical harmonics.

Prerequisite: Ma-124.

ELECTRONICS ENGINEERING (Electromagnetics) 4-0 Es-622

Objective: To continue Es-621.

Description: Maxwell's equations; relations between units; concepts and their validity; retarded potentials; Poisson's equations; boundary values; skin effect and internal impedance; calculation of inductance; propagation of plane electromagnetic waves; reflection of waves; elimination of reflected waves; attenuation; power factor.

Prerequisite: Es-621.

ELECTRONICS ENGINEERING (Electromagnetics) 4-0 Es-623

Objective: To continue Es-622.

Description: Waves guided by lossy plane; waves guided by parallel planes; solution of Maxwell's equations for rectangular and cylindrical wave guides dielectric rod wave guide; radial disk transmission lines; resonant cavities.

Prerequisite: Es-622.

ELECTRONICS ENGINEERING (Electromagnetics) 3-0 Es-624

Objective: To continue Es-623.

Description: Radiation from elementary antenna; Poynting vector calculations; derivation of field patterns for antenna arrays; computation of radiation resistance; long straight wire antenna; rhombic antenna; radiation pattern from end of wave guide; non-uniform transmission line; input impedance of antennas.

Prerequisite: Es-623.

ELECTRONICS ENGINEERING (Antennas, Transmission Lines, and Wave Guides) 3-3 Es-736

Objective: To acquaint the student with the design of antennas, transmission lines, wave guides, and coupling systems; to correlate previous theoretical studies with the practical design of the above.

Description: Shipboard trunks and antennas; efficiency, shielding, and fields of antennas; shore-based antennas, such as rhombic, fishbone, wave, dipole, multiple-tuned, and Marconi; directive antennas; transmission line and wave guides as feeders to antennas; power capabilities and efficiencies of transmission lines and wave guides; transmission lines as matching devices; antennas for VHF and SHF.

Prerequisites: Es-333, Es-624.

ELECTRONICS ENGINEERING (R-F Energy Transmission) 4-2 Es-786

Objective: To acquaint the student with the principles and techniques of energy transmission by means of radio waves.

Description: The following topics are included: R-F transmission lines-characteristic impedance, resonant and non-resonant lines, structural features; antennas - principles of energy radiation and interception, circuit features, the loop antenna, antenna arrays, microwave systems; propagation of radio waves-modes of propagation, propagation characteristics over the R-F spectrum; guided waves-fundamental wave-guide features, applications.

Prerequisites: Es-186, Ph-180.

ELECTRONICS ENGINEERING (Thesis) 2-0 Es-831

Objective: To provide the student with the opportunity for study and research in connection with the preparation of the thesis as required in partial fulfillment of the requirements for the Master's degree.

Description: Individual library and laboratory work; staff consultations.

Prerequisite: First nine terms of Electronics Engineering Curriculum.

ELECTRONICS ENGINEERING (Thesis) 4-0 Es-832

Objective: To continue the objective of Es-831.

Description: Completion of preparation of thesis.

Prerequisite: Es-831.

ELECTRONICS ENGINEERING (Project Seminar) 1-0 Es-836

Objective: To provide the student with the opportunity to prepare and present a report on the project in which he was engaged during his experience at an industrial laboratory.

Description: Individual report preparation; staff consultation; oral presentation of report.

Prerequisite: Industrial laboratory experience.

ELECTRONICS ENGINEERING (Introduction to Electronics) 2-0 Es-991 & 992

Objective: To acquaint the student officer with the general principles, capabilities and limitations of radio, sonar and radar and to give him a limited familiarity with equipment.

Description: This course will continue through two consecutive terms. The following topics will be studied in an elementary manner in class: resonant circuits, principles of vacuum tubes, their action as amplifier, oscillator, detector, modulator, general principles of transmitters and receivers, both AM and FM, antennas, wave propagation, basic principles of radar and sonar.

Prerequisites: None.

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GEOLOGY

Ge Courses

Geology, Physical	Ge-101
Geology of Petroleum	Ge-241
Minerology, Determinative	Ge-302
Petrology	Ge-401

GEOLOGY, Physical 3-0 Ge-101

Objective: To supply the student with the prerequisite background in physical geology for graduate work in petroleum engineering at a civilian university.

Description: The course initiates the student into the study of the various geological phenomena. Among the principle topics discussed are: rock-forming minerals; igneous, sedimentary, and metamorphic rocks; weathering and erosion; stream sculpture; glaciation; surface and sub-surface waters; volcanism; dynamic processes; and structural geology.

Frequent reference is made to other than the prescribed textbook. The course is given as much as possible to stress those topics of particular interest to the petroleum engineer.

Prerequisites: None.

GEOLOGY OF PETROLEUM 3-2 Ge-241

Objective: To supply the student with the prerequisite background in petroleum geology for graduate work in petroleum engineering at a civilian university.

Description: The course includes discussions on the origin, accumulation, and structure which aid in the accumulation of petroleum, its general occurence and distribution. The important oil fields of the world are then taken up in detail as to the occurrence and associated structures in particular fields. The following regions are studied: Eastern United States, Mid-Continent, Gulf Coast, Rocky Mountains, Pacific Coast, North America (except U.S.), West Indies, South America, Europe, Russia, Oceana and Asia.

Prerequisite: Ge-101.

MINERALOGY, DETERMINATIVE 1-4 Ge-302

Objective: To supply the student with the prerequisite background in mineralogy for graduate work in petroleum engineering at a civilian university.

Description: The lectures are designed to familiarize the student with the principles and technique involved in determining minerals in the laboratory. The laboratory periods are spent in the determination of some fifty of the more common minerals by blowpipe, chemical, and crystallographic methods. The student will also be made familiar with the methods employed in the use of chemical microscopy for the determination of certain elements.

Prerequisite: Cr-301.

PETROLOGY 3-4 Ge-401

Objective: To give the student the necessary background in petrology and petrography for graduate work in petroleum engineering at a civilian university.

Description: The course consists of a series of lectures on the differentiation of magmas into the various igneous rock series on the basis of physical chemical theories; the characteristics, structures and textures of igneous rocks; the sedimentary rocks, their origin and types with particular emphasis on the oil-bearing rocks; the metamorphic rocks, mineral alteration, metamorphism and the resultant rock types.

The laboratory work consists of the study of the various rocks in hand speciments, and in thin sections under the petrographic microscope.

When practicable, the course is supplemented by trips to nearby localities to study rocks and minerals in the field.

Prerequisites: Ge-101, Cr-301.

INDUSTRIAL ENGINEERING

IE Lecture Courses

Principles of Industrial Organization I	IE-101
Principles of Industrial Organization II	IE-102
Applied Industrial Organization	IE-103
Psychophysical Systems Research	IE-104

INDUSTRIAL ENGINEERING (Principles of Industrial Organization) 0-1 IE-101

(Lecture Course)

Objective: To familiarize the student officer with the general principles of Industrial Organization, in order to better equip those officers whose future duties may involve production and materiel inspection.

Description: The course is a study of the origin and growth of industrial enterprises, principles of organization, control of production, systems research, standards and standardization, industrial relations, and the effects of science upon industry. This course is presented in a series of ten lectures, given by an authority in the field of Management Engineering, covering the materiel listed above.

Prerequisites: None.

INDUSTRIAL ENGINEERING (Principles of Industrial Organization) 0-1 IE-102

(Lecture and Reading Course)

Objective: To familiarize the student officer with the general principles of Industrial Organization, in order to better equip those officers whose future duties may involve production and materiel inspection.

Description: This course is a study of the origin and growth of industrial enterprises, principles of organization, control of production, systems research, standards and standardization, industrial relations, and the effects of science on industry. This course is presented in a series of ten lectures, given by an authority in the field of Management Engineering, covering the material listed above. Assignments in the text are covered, prior to each lecture, by the students without formal classroom instruction. A final examination is given on the combined material obtained from lectures and text.

Prerequisites: None.

INDUSTRIAL ENGINEERING (Applied Industrial Organization) 0-1 IE-103

(Lecture Course)

Objective: To familiarize the student officer with the organizational structure of major industrial enterprises, in order to better equip those officers whose future duties may involve production and materiel inspection.

Description: This course is a study of the application of the principles of Industrial Organization to the structure of major industrial enterprises. By means of a series of ten lectures, given by representatives of major industries, the overall picture of the structure of major industrial organizations is presented. One lecture is devoted to the broad aspects of a major organization. The succeeding lectures are devoted to the functions of the major echelons of the organization.

Prerequisite: IE-101 or IE-102-

HUMAN ENGINEERING (Psychophysical Systems Research) 0-1 IE-104

(Lecture Course)

Objective: To survey the methods and results of studies of military problems of fitting men and machines together into effective systems in order to

Description: This course consists of study of: the background of research in human engineering; quantitative methods employed in research and tests in this field; optimum physical conditions of operation of instruments; the practical problems of equipment design; basic research on the design of instruments; the design of tasks; the working environment; the appraisal of systems; and the design of systems. This course is presented in a series of lectures by authorities in the field of Psychophysical Systems Research.

Prerequisites: None.

German	La-101
German	La-102
German	La-103
German	La-104
German	La-105
German	La-106
German	La-107
German	La-108
Russian	La-201
Russian	La-202
Russian	La-203
Russian	La-204
Russian	La-205
Russian	La-206
Russian	La-207
Russian	La-208

FOREIGN LANGUAGE (German) 2-0 La-101

Objective: To teach the student officers to read technical German publications in the field of Meteorology.

Description: This course will include study of grammar, sufficient for reading intelligently scientific works in German, use of dictionaries, and practice in translating from German to English. The main emphasis will be placed on the acquisition of a large, technical reading-vocabulary.

Prerequisite: None.

FOREIGN LANGUAGE (German) 2-0 La-102 La-103 La-104 La-105 La-106 La-107 La-108

Objective: To teach the student officer to read technical German publications in the field of Meteorology.

Description: These courses are progressive continuations of the course La-101, and follow one another in the order given. Each course is given in a separate term; is an advancement over the preceding course; and leads to a fulfillment of the objective at the end of the eighth term.

Prerequisite: La-101 or the preceding listed La-course.

FOREIGN LANGUAGE (Russian) 2-0 La-201

Objective: This course aims to develop the ability to read Russian publications in the field of Meteorology.

Description: This course will include study of necessary grammatical constructions for reading, use of dictionaries, and practice in translating material from Russian to English. Chief emphasis will be placed on the acquisition of a large, technical reading-vocabulary.

Prerequisite: None.

FOREIGN LANGUAGE (Russian) 2-0 La-202 La-203 La-204 La-205 La-206 La-208

Objective: To teach the student officers to read technical Russian publications in the field of Meteorology.

Description: These courses are progressive continuations of course La-201, and follow one another in the order given. Each course is given in a separate term; is an advancement over the preceding course; and leads to a fulfillment of the objective at the end of the eighth term.

Prerequisite: La-201 or the preceding listed La-course.

Ma Courses

Ordinary Differential Equations	Ma-101
Series and Vector Algebra	Ma-102
Functions of Several Variables and Vector Analysis	Ma-103
Partial Differential Equations and Related Topics	Ma-104
Fourier Series and Boundary Value Problems	Ma-105
Complex Variable and Laplace Transform	Ma-106
Selected Topics for Fluid Mechanics	Ma-134
Partial Differential Equations and Introduction to Statistics	Ma-135
Selected Advanced Topics	Ma-155
Algebra and Analytic Geometry	Ma-161
Differential and Integral Calculus	Ma-162
Ordinary Differential Equations	Ma-171
Differential Equations and Infinite Series	Ma-172
Partial Differential Equations and Vector Algebra	Ma-173
Vector Analysis and Functions of a Complex Variable	Ma-174
Partial Derivatives and Ordinary Differential Equations	Ma-181
Vector Analysis and Complex Variable	Ma-182
Vector Analysis and Complex Variable	Ma-183
Special Mathematical Methods of Physics	Ma-184
Graphical and Mechanical Computation	Ma-201
Graphical and Mechanical Computation	Ma-251
Statistics	Ma-301
Statistics	Ma-331
Statistics	Ma-351
Statistics	Ma-352
Mathematical Computation by Mechanical Means	Ma-401
Mathematical Computation by Mechanical Means	Ma-451

MATHEMATICS (Ordinary Differential Equations) 5-0 Ma-101

Objective: To give a mathematical foundation for scientific study consisting of three essential components: (a) knowledge of mathematical principles and methods; (b) skill and accuracy in performing mathematical processes, and (c) ability in the use of mathematical analysis in problems and investigations.

Description: Hyperbolic functions; elementary operations with complex numbers; roots of equations by Newton's and Graeffe's methods; partial derivatives; ordinary differential equations including systems of linear differential equations with constant coefficients. Stability criteria.

Prerequisite: A recent course in differential and integral calculus.

MATHEMATICS (Series and Vector Algebra) 5-0 Ma-102

Objective: To advance the knowledge, skill and ability of the student in continuance of the objective of Ma-101.

Description: Taylor series, power series, and operations on series. Introduction to elliptic integrals. Fourier series, Fourier transform, numerical harmonic analysis. Systems of linear equations, rank of a matrix, linear dependence. Vector algebra and solid analytic geometry of planes and lines.

Prerequisite: Ma-101.

MATHEMATICS (Functions of Several Variables and Vector Analysis) 5-0 Ma-103

Objective: To advance the knowledge, skill and ability of the student in continuance of the objective of Ma-102.

Description: Analytic geometry of curves and surfaces and applications of partial derivatives. Differentiation of vectors and applications to kinematics. Vector differential operators. Line, surface and space integrals and applications to volumes, moments, potential and attraction. Divergence theorem and theorems of Green and of Stokes. Curvilinear coordinates. Introduction to analytic functions of a complex variable.

Prerequisite: Ma-102

MATHEMATICS (Partial Differential Equations and Related Topics) 5-0 Ma-104

Objective: To advance the knowledge, skill and ability of the student in continuance and completion of the objective of Ma-103.

Description: Total differential equations and systems of ordinary differential equations. Linear and other first order and special cases of higher order partial differential equations especially those having constant coefficients. Solution of ordinary differential equations in series; gamma, beta, Bessel and Legendre functions; introduction to boundary value problems and orthogonal functions with applications to heat flow, vibrations of strings and membranes and flow of electricity in a cable. Interpolation formulas of Newton, Stirling and Lagrange, quadrature formulas and numerical integration of ordinary differential equations and systems.

Prerequisite: Ma-103

MATHEMATICS (Fourier Series and Boundary Value Problems) 4-0 Ma-105

Objective: To give the student a sound understanding and working knowledge of standard methods for solving the boundary value problems which arise in physics and engineering.

Description: Derivation of some of the partial differential equations of applied mathematics, using vector and other methods. Study of Fourier series, Bessel and Legendre functions and other orthogonal functions. The Sturm-Liouville problem. Solution of boundary value problems by means of orthogonal functions. Uniqueness of the solution.

Prerequisite: Ma-104.

MATHEMATICS (Complex Variable and Laplace Transform) 4-0 Ma-106

Objective: To provide an introduction to the Laplace transform, and to show its application to problems in physics and engineering.

Description: Analytic functions; Laplace transform and its use in solving ordinary differential equations; special theorems and manipulations for the Laplace transform; application to partial differential equations and difference equations.

Prerequisite: Ma-104

MATHEMATICS (Selected Topics in Fluid Mechanics) 4-0 Ma-134

Objective: To continue the objective of Ma-103 by giving the student the mathematical background essential to effective work in meteorology and weather forecasting.

Description: Eulerian equations. Irrotational and vortex motion. Streamlines and trajectories. Linear vector fields. Numerical analysis. Total differential equations and systems of linear differential equations.

Prerequisite: Ma-103

MATHEMATICS (Partial Differential Equations and Introduction to Statistics) 4-0 Ma-135

Objective: To further acquaint the student with the partial differential equations of physics, and to give the fundamentals of the analysis of observational data.

Description: Partial differential equations with applications to heat conduction and wave motion. Gamma, Beta and orthogonal functions. Boundary value problems. Curve fitting and the method of least squares. Preliminary considerations in the analysis of observational data. Fundamentals of probability. Bernouilli and Poisson distributions.

Prerequisite: Ma-134.

MATHEMATICS (Selected Advance Topics) 3-0 Ma-155

Objective: To present selected topics in advanced calculus, algebra, geometry and ordinary differential equations not included in the sequence Ma-101 to Ma-104 but prerequisite for Mc-401, Mc-402, Ma-351 and Ma-352.

Description: Adjoint systems of ordinary linear differential equations; elliptic integrals; differentiation of integrals containing a parameter; quadratic forms in three or more variables; ellipsoid of inertia; extrema of functions of several variables; moving axial systems; angular velocity of a rigid body; elementary algebra of matrices.

Prerequisites: Ma-104; Mc-153 or Mc-112.

MATHEMATICS (Algebra and Analytic Geometry) 5-0 Ma-161

Objective: To provide the minimum mathematics background essential to effective work in meteorology and weather forecasting.

Description: Exponents and logarithms; rectangular coordinates and graphs; quadratic equations; simultaneous linear equations; elements of trigonometry; conic sections; elements of solid analytic geometry.

Prerequisite: None.

MATHEMATICS (Differential and Integral Calculus) 5-0 Ma-162

Objective: To continue and complete the objective of Ma-161.

Description: Derivatives of algebraic, trigonometric and exponential functions; applications of the derivative; differentials; curvature; law of the mean; integration; applications of integrals; partial differentiation; multiple integrals.

Prerequisite: Ma-161.

MATHEMATICS (Ordinary Differential Equations) 3-0 Ma-171

Objective: To give a mathematical foundation for engineering study consisting of three essential components: (a) knowledge of mathematical principles and methods; (b) skill and accuracy in performing mathematical processes; and (c) power in the use of mathematical analysis in problems and investigations.

Description: Hyperbolic functions; elementary operations with complex numbers. Roots of algebraic equations. Partial derivatives. Ordinary differential equations.

Prerequisite: A recent course in differential and integral calculus.

MATHEMATICS (Differential Equations and Infinite Series) 3-0 Ma-172

Objective: To advance the knowledge, skill and ability of the student in continuance of the objective of Ma-171.

Description: Systems of differential equations with constant coefficients. Applications of differential equations. Power series, Taylor series and operations on series. Solution of differential equations in series. Fourier series.

Prerequisite: Ma-171

MATHEMATICS (Partial Differential Equations and Vector Algebra 3-0 Ma-173

Objective: To advance the knowledge, skill and ability of the student in continuance of the objective of Ma-172.

Description: Gamma and Bessel functions. Linear partial differential equations. Boundary value problems and applications. Solid analytic geometry and vector algebra.

Prerequisite: Ma-172.

MATHEMATICS (Vector Analysis and Functions of a Complex Variable) 3-0 Ma-174

Objective: To advance the knowledge, skill and ability of the student in continuance, and in completion of, the objective of Ma-173.

Description: Vector calculus and applications to kinematics. Line, surface and multiple integrals. Vector operators and the theorems of Stokes, Gauss and Green. Applications. Analytic functions of a complex variable and conformal mapping. Cauchy's theorem and formula. Series and residues.

Prerequisite: Ma-173.

MATHEMATICS (Partial Derivatives and Ordinary Differential Equations) Ma-181
5-0

Objective: To develop in the student a mathematical foundation for scientific study consisting of three essential components: (a) knowledge of mathematical principles and methods; (b) discipline in performing mathematical operations; and (c) resourcefulness in applying mathematical analysis to physical problems and investigations.

Description: Partial and total derivatives; normal derivatives; differentials; implicit functions; line integrals; ordinary differential equations of the first order; linear differential equations of higher order. Physical applications.

Prerequisite: A recent course in differential and integral calculus.

MATHEMATICS (Vector Analysis and Complex Variable. Part I) 5-0 Ma-182

Objective: To advance the knowledge, discipline, and resourcefulness of the student in continuance of the objective of Ma-181.

Description: Vector algebra; derivatives of vectors; vector differential operators; differential equations associated with vector fields; algebra of complex numbers; elementary complex functions; derivatives and integrals of complex functions; conformal maps. Physical applications.

Prerequisite: Ma-181.

MATHEMATICS (Vector Analysis and Complex Variable. Part II) 5-0 Ma-183

Objective: To advance the knowledge, discipline, and resourcefulness of the student in continuance of the objective of Ma-182.

Description: Double and triple integrals; surface integrals; integral relations of the Stokes-Gauss types; Cauchy's integral formulas; expansion theory; residues; infinite series; Fourier series and boundary value problems. Physical applications.

Prerequisite: Ma-182.

MATHEMATICS (Special Mathematical Methods of Physics) 5-0 Ma-184

Objective: To advance the knowledge, discipline, and resourcefulness of the student in continuance of the objective of Ma-183.

Description: Special functions of theoretical physics; calculus of variations; numerical methods; matrices; tensors. Physical applications.

Prerequisite: Ma-183.

MATHEMATICS (Graphical and Mechanical Computation) 0-2 Ma-201

Objective: To give the student, by means of practical laboratory work, an understanding of the construction and use of nomographic charts, and to give the student practice in using the planimeter and the three-wheel integrator.

Description: The course includes construction of uniform and non-uniform scales, systems of curves for equations in three variables, use of logarithmic and semi-logarithmic coordinate paper, construction of alignment charts and the theory and use of planimeters and integrators.

Prerequisites: None.

MATHEMATICS (Graphical and Mechanical Computation) 0-4 Ma-251

Objective: To give the student practice in modern methods used in designing diagrams and nonograms, and to give the student practice in using the planimeter and the three-wheel integrator.

Description: The course consists of twenty exercises each occupying one laboratory period. Two exercises are in the theory and use of the planimeter and integrator. The remaining exercises are devoted to the design of diagrams, including: construction of scales to show relations between two variables; construction of nomograms with families of lines or curves to show relations among three variables; alignment diagrams for three variables involving curved scales and curve nets; diagrams for more than three variables and diagrams with more than one index line; alignment diagrams with adjustment for equations in three or more variables; the Lafay-Wertheimer method for constructing a chart or alignment diagram from empirical curves.

Prerequisites: None.

MATHEMATICS (Statistics) 3-2 Ma-301

Objective: To acquaint the student with modern statistical techniques for making use of observed data.

Description: Fundamental principles of probability. Probability distributions with special emphasis on the binomial, Poisson and normal distributions. Correlation. Introduction to sampling theory and its use in testing hypotheses Introduction to qualify control and sampling inspection programs.

Prerequisite: Ma-102.

MATHEMATICS (Statistics) 4-2 Ma-33I

Objective: To familiarize the student with the fundamental principles of statistical analysis, and to prepare the student to draw statistical inferences from observed data.

Description: Continuous frequency distributions. The Pearson and Gram-Charlier systems. Correlation: simple, multiple and partial. Non-linear regressions. Sampling theory and the testing of hypotheses. Applications to problems in aerology.

Prerequisite: Ma-135.

MATHEMATICS (Statistics) 2-0 Ma-351

Objective: To familiarize the student with certain fundamental principles of probability and statistics with particular reference to applications in Ordnance Engineering.

Description: Classical probability; frequency distributions, averages and measures of dispersion; binomial, Poisson and normal distributions; least squares and observational equations.

Prerequisite: Ma-154.

MATHEMATICS (Statistics) 2-2 Ma-352

Objective: To prepare the student of Ordnance Engineering to handle the analysis and interpretation of observed data and to draw statistical inferences.

Description: Correlation of theory; sampling distributions of averages and variance, exact and asymptotic; tests of the null hypothesis concerning means and variances; analysis of variance; statistical estimation and optimum estimates; applications to gunnery and to acceptance tests.

Prerequisite: Ma-351.

MATHEMATICS (Mathematical Computation by Mechanical Means) 2-0 Ma-401

Objective: To provide the student with a wide knowledge of the mechanical devices which can be combined to perform mathematical computations automatically and to enable him to consider combinations of such devices analytically.

Description: A wide variety of elementary devices which may be used to perform mathematical operations is considered together with instruments which combine them so as to solve problems largely without human intervention.

Prerequisite: Ma-103.

MATHEMATICS (Mathematical Computation by Mechanical Means) 2-2 Ma-451

Objective: (1) To provide certain ordnance specialists with wide knowledge and thorough understanding of some of the mechanical means which have been and are at present employed to solve mathematical problems; (2) to correlate this material with ordnance equipment and problems; (3) to develop intellectual independence and self-reliance by study of the subject material in the original sources.

Description: The theory and details of design of a wide variety of elementary and compound devices which may be used to perform mathematical operations mechanically are studied. Their relations to ordnance problems and equipment are considered. In so far as possible some of the subject material is presented to the class by the students in informal reports.

Prerequisite: Ma-103.

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MECHANICS

Mc Courses

Statics and Kinematics	Mc-111
Kinetics	Mc-112
Statics, Kinematics and Kinetics	Mc-141
Dynamics and Special Topics	Mc-142
Statics and Kinematics	Mc-151
Kinetics	Mc-152
Further General Laws and Dimensional Analysis	Mc-153
Topics in Advanced Dynamics	Mc-201
Vibrations	Mc-311
Dynamics of Engine and Shaft	Mc-341
Exterior Ballistics	Mc-401
Dynamics of a Rigid Body	Mc-402
Interior Ballistics	Mc-421
Strength of Guns	Mc-431

MECHANICS (Statics and Kinematics) 5-0 Mc-111

Objective: To give the student a working knowledge of the fundamental principles of engineering mechanics by the study of statics and kinematics.

Description: Fundamental principles for forces and couples. Resultants and equilibrium for force systems and couples in a plane and in space. Applications to trusses, cables, and friction. Phantom members and their use. First and second moments. Ellipses of inertia and of gyration. The Mohr circle. Kinematics of a particle and of a rigid body. Kinetics of a particle.

Prerequisites: None.

MECHANICS (Kinetics) 3-0 Mc-112

Objective: To complete the objective of Mc-111 by the study of kinetics.

Description: Virtual work. Translation, rotation, and plane motion of a rigid body. Principles of work and energy, and of impulse and momentum. Free and forced vibrations with and without damping. Balancing. Gyroscopic couple. Coriolis's law. Dimensional analysis.

Prerequisite: Mc-111.

MECHANICS (Statics, Kinematics, and Kinetics) 4-0 Mc-141

Objective: To give the student a working knowledge of the fundamental principles of engineering statics, and an introduction to the kinetics of a particle and of bodies.

Description: Fundamentals; resultants for force systems in the plane and in space; equilibrium for force systems in the plane and in space; friction; first moments and centroids, moments of inertia; kinematics of a particle and of a rigid body; kinetics of a particle; translation and rotation of a rigid body, inertia force method for translation of a rigid body.

Prerequisites: None.

MECHANICS (Dynamics and Special Topics) 3-0 Mc-142

Objective: To give the student a working knowledge of the fundamental principles of engineering dynamics.

Description: Inertia force method for rotation of a rigid body, plane motion of a rigid body; work, power and energy; impulse and momentum; mechanical vibrations, relative motion and moving coordinates; dimensional analysis.

Prerequisite: Mc-141.

MECHANICS (Statics and Kinematics) 3-0 Mc-151

Objective: To give the student a working knowledge of mechanics by study of the fundamental principles of statics and kinematics.

Description: Vectors, components, composition and resolution in a plane and in space; concurrent forces, two force pieces, force polygon, equilibrium under concurrent forces; coplanar forces, resultants, couples, equivalent systems, reduction to force and a couple, equilibrium, friction; forces in space, equivalent systems, the wrench, equilibrium; centers of gravity, moments of inertia, centroids, radii of gyration, transfer theorems, inclined axes, products of inertia, principal axes; kinematics of a point and of a rigid body in a plane, translation, rotation, general motion, instantaneous center, tangential and normal components of acceleration, radial and transverse components of acceleration, relative acceleration of points in plane motion.

Prerequisites: None.

MECHANICS (Kinetics) 3-0 Mc-152

Objective: To continue the objective of Mc-151 by the study of kinetics.

Description: Concepts of mass and force, Newton's laws, differential equations for translation of a particle, connected bodies, harmonic vibrations, projectile motion; impulse and momentum, impact, conservation of linear momentum, angular momentum; work and kinetic energy, motion of particle under the action of gravity, power; dynamics of rigid bodies, effective force, d'Alembert's principle, differential equations of motion for motion of a rigid body, the compound pendulum, the conical pendulum, plane motion, kinetic energy in plane motion, work and power in plane motion, impulse and momentum, rolling with and without slipping; gyroscopic motion.

Prerequisite: Mc-151.

MECHANICS (Further General Laws and Dimensional Analysis) 2-0 Mc-153

Objective: To complete the objective of Mc-151 by the study of certain further general laws of dynamics for systems of particles and by the study of dimensional analysis.

Description: Definitions of dynamical system, internal and external forces, centroid, linear momentum, angular momentum, transfer theorems for angular momentum, differential equations of motion, conservative forces, conservation theorems; moving axes, Coriolis acceleration; potential and potential energy; dimensional analysis, primary and secondary quantities, definition of dimensions, units, change of units, dimensional equations, the pi-theorem.

Prerequisite: Mc-152.

MECHANICS (Topics in Advanced Dynamics) 2-2 Mc-201

Objective: To provide the student with some advanced methods in dynamics, and to provide him with practice in obtaining the differential equations for mechanical systems.

Description: Determination of the equations of motion in the case of plane motion; generalized coordinates and the equations of motion for systems with several degrees of freedom; normal coordinates and small oscillations; equations of Lagrange. Applications to engineering problems in mechanical vibrations receive special attention.

Prerequisites: Ma-103 and one of Mc-112, Mc-142 or Mc-153.

MECHANICS (Vibrations) 3-2 Mc-311

Objective: To present to the student in Aeronautical Engineering the mathematical theory of vibrations due to the dynamical loading of elastic bodies.

Description: Kinematics of vibration. Rational mechanics of elastic bodies and general solution of the dynamical equations. Solution by Fourier series; harmonic analysis. Applications to beams, shafts, propellers. Vibrations due to reciprocating masses in engines. Experimental determination of vibrational parameters. Airplane-wing flutter.

Prerequisites: Ma-104, Mc-112.

MECHANICS (Dynamics of Engine and Shaft) 3-0 Mc-341

Objective: To give the student a practical understanding of the forces operating in reciprocating engines and of the problems involving balance and vibrations of engines and shafting.

Description: Motion of pistons and connecting rods of reciprocating mechanisms, with determination of harmonics of inertia forces. Balance of shaking forces, rocking moments, and rolling moments for engines with cylinders in line, with two or more banks, and radial engines. Analysis of turning moment for two and four-cycle engines. Study of free and forced vibrations of elastic bodies, with emphasis on frequencies and resonance characteristics of elastic bars and shafting with various types of loading. Particular attention is given to torsional and transverse vibrations of a rotating shaft due to torsional impulses and to unbalanced rotors.

Prerequisite: Ma-103.

MECHANICS (Exterior Ballistics) 3-0 Mc-401

Objective: To instruct the student in those fundamental principles and methods of exterior ballistics which are common to surface fire, to antiaircraft fire, and to bombing.

Description: The topics which are presented include the vacuum trajectory, air resistance, various forms of drag function, the Siacci method, numerical integration of the differential equations of motion under normal conditions, differential corrections for abnormal conditions, weighting factors, and integration of the adjoint system. The projectile is treated as a mass particle, stability considerations being deferred until a later course (Mc-402).

Prerequisites. Ma-155, Mc-153 or Mc-112.

MECHANICS (Dynamics of a Rigid Body) 3-0 Mc-402

Objective: To prepare the student to attack effectively many problems involving the principles of rigid body dynamics; in particular, to apply these principles to certain problems in exterior ballistics.

Description: The fundamental principles of the dynamics of rotating rigid bodies are emphasised throughout the course. These principles are applied to a variety of mechanical systems, in an effort to train the student to analyze many other physical problems than those specifically discussed. Among the latter are: the effect of the earth's rotation on long trajectories; the motion of a gyroscope under various constraints; and the stability of a rotating projectile in flight.

Prerequisite: Mc-401.

MECHANICS (Interior Ballistics) 2-0 Mc-421

Objective: To acquaint the student with the rational and experimental foundations of interior ballistics, and to teach him how to use some of the methods currently employed.

Description: Those thermodynamic and mechanical concepts and relations which are fundamental to all interior ballistics systems are treated early in the course. These topics are followed by detailed studies (including computational exercises) in particular systems, among which are the LeDuc system and several of those developed during the two World Wars.

Prerequisites: Ma-103, Mc-152, Ch-101.

MECHANICS (Strength of Guns) 3-0 Mc-431

Objective: To instruct the student in the more important theories of gun strength and to teach him to construct the strength curves for both built-up and radially-expanded guns.

Description: Fundamental principles in the theory of elasticity and strength of materials are presented during the first part of the course, and are then applied to yield the classical thick-cylinder formulas. This is followed by a discussion of those theories of strength which have been employed in the design of guns. Detailed studies, with accompanying computational exercises, are made of the maximum strain theory, for the case of built-up guns, and of the Duguet theory of radial expansion.

Prerequisites: Ma-104, Mc-151, ME-500.

Engineering Thermodynamics	ME-111
Engineering Thermodynamics	ME-112
Engineering Thermodynamics	ME-122
Engineering Thermodynamics	ME-131
Engineering Thermodynamics	ME-132
Chemical Engineering Thermodynamics	ME-141
Chemical Engineering Thermodynamics	ME-142
Chemical Engineering Thermodynamics	ME-143
Meteorological Thermodynamics	ME-151
Meteorological Thermodynamics	ME-152
Power Plant Equipment (Marine)	ME-211
Power Plant Equipment (Marine)	ME-212
Internal Combustion Engines	ME-213
Internal Combustion Engines	ME-214
Power Plant Analysis (Marine)	ME-215
Power Plant Design (Marine)	ME-216
Power Plant Equipment (Marine)	ME-221
Power Plant Analysis (Marine)	ME-222
Heat Transfer	ME-310
Hydraulic Equipment	ME-411
Hydrodynamics	ME-412
Hydraulic Equipment	ME-420
Hydraulic Equipment	ME-460
Strength of Materials	ME-500
Strength of Materials	ME-511
Advanced Strength of Materials	ME-512
Advanced Strength of Materials	ME-522
Introduction to the Theory of Elasticity	ME-590
Materials Testing Laboratory	ME-601

Materials Testing Laboratory	ME-611
Experimental Stress Analysis	ME-632
Experimental Stress Analysis	ME-634
Mechanics of Machinery	ME-700
Dynamics of Machinery	ME-710
Machine Design	ME-811
Advanced Machine Design	ME-812 ME-812a
Machine Design	ME-830
Manufacturing Engineering	ME-840

THERMODYNAMICS (Engineering) 4-2 ME-111

Objective: To provide, in conjunction with course ME-112 or 122, adequate understanding of the principles of engineering thermodynamics, with emphasis on those aspects that are essential for subsequent studies of marine power plant equipment.

Description: The studies include the classifications of energy and its accounting, the mechanical availability limitations and entropy of energy, the thermodynamic properties of liquids and vapors and their changes in representative processes, and like considerations relating to low-pressure or ideal gases. The laboratory periods are used for student solution of numerous related practical problems and the development of skeleton thermodynamic diagrams.

Prerequisite: Ma-102

THERMODYNAMICS (Engineering) 4-2 ME-112

Objective: To provide, in continuation of course ME-111, adequate understanding of the principles of engineering thermodynamics, with emphasis on those aspects that are essential for subsequent studies of marine power plant equipment.

Description: The studies include the kinetic theory of gases, the thermodynamic properties of low pressure gas and gas-vapor mixtures and their changes in representative processes, like considerations relating to higher pressure non-ideal fluids and as organized through the use of residual functions, and the thermochemistry and thermodynamics relating to the release of chemical energy by combustion. The laboratory periods are used for student solution of numerous related practical problems.

Prerequisite: ME-111.

THERMODYNAMICS (Engineering) 4-2 ME-122

Objective: To provide, in continuation of course ME-111, adequate understanding of the principles of engineering thermodynamics, with emphasis on considerations relating to operational aspects of marine power plant equipment.

Description: The studies include the thermodynamic properties of low pressure gas and gas-vapor mixtures and their changes in representative processes, the thermo-chemistry and thermodynamics relating to the release of chemical energy by combustion, the general methods employed in the analysis of steady-state heat transfer processes, and full analysis of the performance characteristics of a modern marine boiler. The laboratory periods are used in part for student solution of related practical problems and in part for tests of various heat transfer equipment.

Prerequisite: ME-111.

THERMODYNAMICS (Engineering) 3-2 ME-131

Objective: To provide, in conjunction with course ME-132, adequate understanding of the principles of engineering thermodynamics, with emphasis on considerations of greater concern in relation to aircraft and aircraft power plants.

Description: The studies include the classifications of energy and its accounting, the mechanical availability limitations and entropy of energy, the thermodynamic properties of low pressure gases and vapors and their changes in representative processes. The laboratory periods are used for student solution of related practical problems and the development of skeleton thermodynamic and hygrometric diagrams.

Prerequisite: Ma-102.

THERMODYNAMICS (Engineering) 3-2 ME-132

Objective: To provide, in continuation of course ME-131, adequate understanding of the principles of engineering thermodynamics, with emphasis on considerations of greater concern in relation to aircraft and aircraft power plants.

Description: The studies include the thermodynamic properties of low-pressure gas and gas-vapor mixtures and their changes in representative processes, the thermo-chemistry and thermodynamics relating to the release of chemical energy by combustion, with attention to equilibrium, and the accelerative flow of compressible fluids through nozzles and orifices at sub- and supersonic speeds. The laboratory periods are used for the most part for student solution of related practical problems.

Prerequisite: ME-131.

THERMODYNAMICS (Chemical Engineering) 4-2 ME-141

Objective: To provide, in conjunction with course ME-142 or ME-143, adequate understanding of the principles of engineering thermodynamics, including chemical engineering aspects, with emphasis on those topics essential for subsequent studies of explosives, torpedo power plants, jet engines, etc.

Description: This course is an introduction to the fundamental concepts of thermodynamics; energy and its accounting, availability of energy, the thermodynamic properties of pure substances and their changes in various processes, including chemical interaction.

The laboratory periods are used for student solution of practical problems chosen to illustrate the principles discussed in the classroom.

Prerequisite: Ma-103.

THERMODYNAMICS (Chemical Engineering) 2-2 ME-142

Objective: To provide, in continuation of course ME-142, adequate understanding of the principles of thermodynamics, with emphasis on those aspects that are essential for subsequent studies of explosives, torpedo power plants, jet engines, etc.

Description: Organization of the thermodynamic properties of non-ideal gases through the use of the residual functions, preparation and use of thermodynamic diagrams for simple systems of ideal and of non-ideal gases and for complex systems in chemical equilibrium, heat and work effects in representative processes involving complex mixtures of the products of combustion.

The laboratory periods are used for student solution of practical problems to illustrate the principles discussed in the classroom.

Prerequisite: ME-141.

THERMODYNAMICS (Chemical Engineering) 4-4 ME-143

Objective: To provide, in continuation of course ME-142, the principles of chemical and engineering thermodynamics, with emphasis on considerations relating to power plants operating on non-standard fluids.

Description: The application of thermodynamic facilities to power plants operating on non-standard fluids such as jet engines and torpedo motors; nozzle and blading design factors, performance characteristics, etc. A brief introduction to heat transfer is included.

The laboratory periods are used for student solution of practical problems of related nature.

Prerequisites: ME-142.

THERMODYNAMICS (Meteorological) 3-1 ME-151

Objective: To provide, in conjunction with course ME-152, adequate understanding of the principles of meteorological thermodynamics and their application in relation to atmospheric phenomena.

Description: The studies include the classifications of energy and its accounting, the mechanical availability limitations and entropy of energy, the thermodynamic properties of dry air and their changes in representative atmospheric processes, the primary network of the meteorological types of thermodynamic diagrams, and uses of these diagrams in soundings representations, altimetry et cetera. The laboratory periods are used for student solution of related practical problems and the development of skeleton thermodynamic diagrams.

Prerequisite: Ma-102.

THERMODYNAMICS (Meteorological) 4-2 ME-152

Objective: To provide, in continuation of course ME-151, adequate understanding of the principles of meteorological thermodynamics and their application in relation to atmospheric phenomena.

Description: The studies include the thermodynamic properties of water at low pressure in solid, liquid and vapor phases and in metastable states, the properties and conventional meteorological indices of the thermodynamic state of low-pressure air-vapor mixtures, the changes of these properties and indices during representative atmospheric processes, the supplementary lines enabling representation of mixture states and state changes on the thermodynamic diagrams, the multipressure hygrometric chart, thermodynamic aspects of stability or instability, of convection and of the air maps, and air mass identification indices and their relative conservatism. The laboratory periods are used for student solution of related practical problems and further development of skeleton thermodynamic diagrams and the hygrometric chart.

Prerequisite: ME-151.

POWER PLANT EQUIPMENT (Marine) 3-2 ME-211

Objective: To provide adequate understanding of the principles of the heat-power and heat-pump plants in representative marine arrangements, with major attention to them as aggregates and deferring more detailed attention to individual components in courses ME-212, 213 and 214.

Description: The studies include full analysis of the performance characteristics of a modern marine boiler, the controlling principles, essential features and performance indices and characteristics of the simpler and more complex marine steam power plant, and like considerations relating to the internal-combustion turbine power plant and the heat-pump plant. The laboratory periods are used for the most part for tests of a marine steam boiler, various other heat transfer equipment, et cetera.

Prerequisites: ME-111, ME-112, ME-310, ME-411.

POWER PLANT EQUIPMENT (Marine) 3-4 ME-212

Objective: To provide and apply the principles controlling the design and performance of individual items of the marine power plant, but with attention primarily to thermal aspects (and excepting the reciprocating-piston type of internal combustion engine).

Description: The studies include the accelerative flow of compressible fluids through orifices, nozzles and ducts, at both subsonic and supersonic speeds, the reactive effects of such flow, thermodynamic aspects of the turbine engine and reciprocating steam engine, the air compressor and refrigeration and air-conditioning equipment. As time permits, attention is given to the general thermodynamic equations. The laboratory periods are used in part for student solution of related practical problems and in part for laboratory tests of related equipment.

Prerequisite: ME-211.

INTERNAL COMBUSTION ENGINES 3-2 ME-213

Objective: Study of the principles of the fundamental internal combustion engine cycles, with particular emphasis on compression-ignition engines, and the variables affecting their application and operation.

Description: The classroom work consists of the study of the combustion process as applied to these types of engines, the air-fuel ratio and the resultant exhaust gas mixtures, the cyclic processes, the capacity and efficiency, the variables that affect the capacity and performance, the fuels used.
The laboratory work is a series of tests to determine the volumetric and mechanical efficiencies and the speed-torque characteristics of these engines.

Prerequisites: ME-111, ME-112.

INTERNAL COMBUSTION ENGINES 3-2 ME-214

Objective: To continue the objective of ME-213, with further study of the additional variables in the real engine, and the construction and performance of typical engines.

Description: The study consists of the injection and its timing with its influence on performance, combustion chamber design, the effects of these variables on capacity and efficiency, fuel systems, accessories and construction of engines. Lectures are given by experienced Naval and Engineering personnel. The laboratory work is a series of tests which include injection timing, capacity under varying conditions, and an indicator card analysis.

Prerequisite: ME-213.

POWER PLANT ANALYSIS (Marine) 2-4 ME-215

Objective: To develop, in conjunction with course ME-216, competence in the selection, arrangement and procurement of marine power plant equipment.

Description: The studies include the methods of estimating the main and auxiliary power requirements of typical naval vessels, the inter-relation of individual items of equipment and the evaluation of flow diagrams and energy distribution sheets for representative power plants. The P.W. periods are used largely in related computations and compilations.

Prerequisites: ME-212, ME-310, and ME-412.

POWER PLANT DESIGN (Marine) 2-4 ME-216

Objective: To develop, in continuation of course ME-215, competence in the selection, arrangement and procurement of marine power plant equipment.

Description: The studies relate to the development of the design of the power installation of a modern naval vessel, including correlation of the objectives of the Navy and the functions of the contractor, the influences of operating conditions on the energy distribution, economy and performance of the plant, the interdependence of individual items of equipment and specifications for their purchase, existing arrangements and promising future ones, et cetera. The available time is distributed between student computations, lectures and seminar.

Prerequisite: ME-215.

POWER PLANT EQUIPMENT (Marine) 4-4 ME-221

Objective: To provide adequate understanding of the principles controlling the arrangement and performance of marine power plant installations and equipment, with attention primarily to thermal aspects of these (but excepting the reciprocating-piston type of internal combustion engine, course ME-213).

Description: The studies include the controlling principles, essential features and performance indices of the simpler and more complex marine steam power plant, like considerations relating to the internal combustion turbine plant and the refrigerations cycles, the flow of compressible fluids through orifices and nozzles, thermodynamic aspects of the turbine engine and reciprocating steam engine, the air compressor and air-conditioning equipment. The laboratory periods are used for the most part in tests of related equipment.

Prerequisite: ME-122.

POWER PLANT ANALYSIS (Marine) 0-6 ME-222

Objective: To develop suitable appreciation of the arrangement and inter-relation of the various components of the marine power plant, and the factors influencing plant economy and performance.

Description: The studies include the marine boiler but in the main relate to the evolution of the flow diagram and energy distribution sheets of the power plants of representative naval vessels, and to the influences affecting power requirements and plant economy.

Prerequisite: ME-221.

HEAT TRANSFER 3-2 ME-310

Objective: To provide adequate information of the laws of heat transfer and their application in the design and selection of marine heat-transfer equipment.

Description: The studies include ground characteristics of representative thermal circuits, thermal conduction in steady and unsteady states, free and forces convection and their combination with conduction, radiative heat transfer and its combination with conduction and convection, and heat transfer involving evaporation and condensation. The P.W. periods are used in part for student solution of related problems and in part for laboratory tests of related equipment.

Prerequisites: ME-112, ME-411.

HYDRAULIC EQUIPMENT 4-2 ME-411

Objective: To provide (in conjunction with ME-412) the principles of hydromechanics, with more specific reference to applications that are the concern of the marine engineer.

Description: The studies include the mechanic properties of liquids, hydrostatic pressures and forces on submerged surfaces and associated matters of buoyance and ship stability, energy aspects of liquid flow, the resistance to such flow through pipes, liquid flow metering and control and the employment of these in hydraulic force transmission and arrester systems, the dynamic forces associated with flow through confining channels, the centrifugal pump and hydrodynamic coupling, et cetera. The principles of dynamic similarity and dimensional analysis are developed and employed extensively. The P.W. periods are used for students' solution of related practical problems and for related laboratory tests.

Prerequisite: Ma-103.

HYDRODYNAMICS 4-2 ME-412

Objective: To provide, in continuation of ME-411, the principles of hydromechanics, with more specific reference to applications that are of concern to the marine engineer.

Description: The studies include the synthesis of the flow pattern and the dynamic force and pressure distribution about symmetrical submerged bodies and unsymmetrical submerged bodies, the associated resistance to relative motions of the bodies and also of the surface vessel, the principles of the propeller and the propeller pump, and the use of the principles of dynamic similarity and dimensional analysis in organizing model test data.

Prerequisites: ME-411; Ma-104.

HYDRAULIC EQUIPMENT 4-4 ME-420

Objective: To provide the fundamentals of practical fluid mechanics and their application in problems in naval hydraulic equipment and vessels.

Description: The studies include the mechanical properties of liquids, the hydrostatic pressure and forces on submerged surfaces and associated matters of buoyance and ship stability, energy aspects of liquid flow, the resistance to such flow through pipes, liquid flow metering and control, the dynamic forces associated with flow through confining channels, the centrifugal pump and hydrodynamic coupling and their performance characteristics, and some consideration of the flow pattern about submerged bodies and of the resistance to motion of the submerged and surface vessel. The principles of dynamic similarity and dimensional analysis are developed and employed extensively. The P.W. periods are used for student solution of related practical problems and for related laboratory tests.

Prerequisites: MA-174, Ma-201; Mc-143.

HYDRAULIC EQUIPMENT 4-2 ME-460

Objective: To provide the principles of hydromechanics, with more specific reference to applications that are of concern to the ordnance engineer.

Description: The studies include the mechanical properties of liquids, hydrostatic pressures and forces on submerged surfaces, energy aspects of liquid flow, the resistance to such flow through pipes, liquid flow metering and control and the employment of these in arrester and force transmission systems, the dynamic forces associated with flow, and introduction to the studies of the flow pattern and pressure distribution about symmetrical and unsymmetrical submerged surfaces. The principles of dynamic similarity and dimensional and analysis are developed and employed extensively. The P.W. periods are used for student solution of related practical problems and related laboratory tests.

Prerequisites: MA-103; Ma-251; Mc-153.

STRENGTH OF MATERIALS 3-0 ME-500

Objective: To present a general service course of fundamental training in the elements of strength of materials.

Description: The course includes the following topics: tensile and compressive stresses, shearing stress, thin-walled cylinders, combined stresses, analysis of plane strain, torsion of circular sectioned members, elementary beam theory, combined loadings and columns.

Prerequisites: Ma-101 or Ma-102, Mc-111, Mc-141 or Mc-151.

STRENGTH OF MATERIALS 5-0 ME-511

Objective: To present fundamental training in the elements of strength of materials.

Description: The course includes the following topics: tensile and compressive stresses, shearing stress, thin-walled cylinders, combined stresses, analysis of plane strain, torsion of circular sectioned members, elementary beam theory, statically indeterminate problems in bending.

Prerequisites: Ma-104 and Mc-143 or the equivalent.

ADVANCED STRENGTH OF MATERIALS 5-0 ME-512

Objective: To present advanced training in the elements of strength of materials.

Description: The course includes the following topics: continuous beams, beams on elastic foundations, problems having radial symmetry, combined loading, columns, strain energy, curved beams, thin plates and thick cylinders.

Prerequisite: ME-511.

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ADVANCED STRENGTH OF MATERIALS 3-0 ME-522

Objective: To present advanced training in the elements of strength of materials.

Description: The course includes the following topics: combined loading, columns, strain energy, curved bars, thin plates and thick cylinders.

Prerequisite: ME-511.

INTRODUCTION TO THE THEORY OF ELASTICITY 3-0 ME-590

Objective: To present fundamental training in the theory of elasticity and its applications.

Description: The course will include the following topics: plane stress considerations, differential equations of equilibrium and compatibility, the Airy stress function, curvilinear coordinates, problems in plane stress and plane strain, three dimensional stress considerations, St. Venant's theory of torsion, energy considerations.

Prerequisites: ME-512 and Ma-104.

MATERIALS TESTING LABORATORY 0-2 ME-601

Objective: To give the student training in the standard practices employed in the testing of engineering materials and in the operation of laboratory equipment.

Description: The course includes experiments involving most of the standard tests used in the determination of the physical properties of engineering materials. These tests are: tension, compression, torsion, shear, transverse bending, impact, hardness and fatigue.

Prerequisite: This course may be taken concurrently with ME-500.

MATERIALS TESTING LABORATORY 2-2 ME-611

Objective: To give the student fundamental training in the testing of materials, the theories of elastic failure and the evaluation of experimental data.

Description: The course includes a study of the theories of elastic failure, the evaluation of experimental errors, standard methods and procedures in tension, compression, torsion, bending and hardness testing; column and fatigue tests.

Prerequisite: ME-511.

EXPERIMENTAL STRESS ANALYSIS 2-2 ME-632

Objective: To give the student training in the theory, methods and techniques of experimental stress analysis.

Description: The course includes an introduction to the theory of elasticity; the use of models in the solution of engineering problems; strain gage technique; photoelasticity; photogrid; brittle material models; brittle lacquer; fatigue tests. Laboratory projects will be assigned in which the various facilities available in experimental stress analysis will be used.

Prerequisite: ME-512 or Ae-204.

EXPERIMENTAL STRESS ANALYSIS 3-2 ME-634

Objective: To give the student training in the theory, methods and techniques of experimental stress analysis.

Description: Dimensional analysis; strain gage technique; theory and application of the various experimental stress analysis methods; membrane analogy; presentation of experimental data. Laboratory projects will be assigned in which the various facilities available in experimental stress analysis will be used.

Prerequisite: ME-590.

MECHANICS OF MACHINERY 3-2 ME-700

Objective: To give the student training in mechanisms, in kinematics and in dynamics of machinery, using graphical methods.

Description: This is a general service course. The following topics are studied; Linkwork, cams, toothed gearing, trains of mechanisms, velocities, accelerations, static forces and inertia forces in machine members.
The practical work periods are devoted to the solution on the drawing board of selected problems.

Prerequisite: Mc-112 or equivalent.

DYNAMICS OF MACHINERY 3-2 ME-710

Objective: To teach the Naval Engineering students the basic methods employed in the solution of problems in the fields of balancing and mechanical vibrations.

Description: Multicylinder, in line, engines are analyzed to determine completely the unbalance resulting from the forces of rotation and reciprocation, using Fourier series to determine the various harmonics of unbalance. The vibratory motions of the engine frame as well as those of the crank shfat are studied and proper dynamic vibration absorbers are designed to remove certain objectionable harmonics.

Prerequisites: Ma-104, Mc-143, ME-511.

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DYNAMICS OF MACHINERY 3-2 ME-730

Objective: To teach the students in Aeronautical Engineering the basic methods employed in the solution of problems in the fields of balancing and mechanical vibrations.

Description: Aircraft engines are analyzed to determine completely the unbalance resulting from the forces of rotation and reciprocation, using Fourier series to determine the various harmonics of unbalance. The vibratory motions of the engine frames as well as those of the crankshaft are studied and proper dynamic vibration absorbers are designed to remove certain objectionable harmonics.

Prerequisites: Ma-114, Mc-112, U-24.

MACHINE DESIGN 3-2 ME-811

Objective: To teach the students in Naval Engineering to analyze problems in the field of machine design.

Description: The following topics are studied in this course: theories of failure, creep, fatigue, working stresses, factor of safety, riveted and welded joints, bolts, screws, keys, cotters, knuckle joints, cylinders, tubes, cylinder heads, springs, and gears.

Practical work periods are devoted to the analysis and solution of problems encountered in the design of simple machine members.

Prerequisites: ME-522 or equivalent, ME-700.

ADVANCED MACHINE DESIGN 3-4 3-2 ME-812
ME-812a

Objective: To give the students in Naval Engineering design advanced training in machine design.

This course is the second of the sequence ME-811 or ME-812 for students in Naval Engineering design.

Description: Several practical design projects will be completed on the drawing board. The projects will give the students an opportunity to combine theory with practice. The drawings involved in the projects will be completely dimensioned, with proper fits, proper selection of materials, proper tolerances to permit interchangeable manufacture.

The objective is to create designs which may actually be built.

Prerequisite: ME-811.

MACHINE DESIGN 3-2 ME-830

Objective: To teach the students in aeronautical engineering to analyze problems in the field of machine design.

Description: The following topics are studied in this course: theories of failure, creep, fatigue, working stresses, factor of safety, riveted and welded joints, bolts, screws, keys, cotters, knuckle joints, cylinders, tubes, cylinder heads, springs, and gears.

Practical work periods are devoted to the analysis and solution of problems encountered in the design of simple machine members.

Prerequisites: ME-700, U-24.

MANUFACTURING ENGINEERING 3-2 ME-840

Objective: To teach the students in Ordnance Engineering the principles of manufacturing engineering necessary for further study in Industrial Engineering.

Description: The following topics are studied: The principles of interchangeable manufacture, the selection of and use of the proper machine tools to fulfill a specific requirement, the details of gage design and inspection methods with reference to proper fits and tolerances. Several industrial plans will be visited where lectures on the use of machines will be provided.

Prerequisite: ME-811.

AEROLOGY

Mr Courses

Principles of Meteorology	Mr-100
Fundamentals of Atmospheric Circulation	Mr-101
Radiological Defense	Mr-110
Introduction to Synoptic Meteorology	Mr-200
Weather Maps and Codes	Mr-201
Surface Weather Maps Analysis and Forecasting	Mr-202
Weather Analysis and Forecasting	Mr-203
Advanced Weather Analysis and Forecasting	Mr-204
Upper-Air Analysis	Mr-205
Introduction to Synoptic Meteorology	Mr-210
Weather Maps and Codes	Mr-211
Surface Weather Map Analysis	Mr-212
Map Analysis and Forecasting	Mr-213
Weather Analysis and Forecasting	Mr-214
Weather Analysis and Forecasting	Mr-221
Weather Analysis and Forecasting	Mr-222
Advanced Weather Analysis and Forecasting	Mr-223
Advanced Weather Analysis and Forecasting	Mr-224
Upper-Air Analysis	Mr-225
Southern Hemisphere and Tropical Meteorology	Mr-228
Selected Topics in Applied Meteorology	Mr-229
Synoptic Meteorology	Mr-301
Synoptic Meteorology	Mr-302
Dynamic Meteorology	Mr-321
Dynamic Meteorology	Mr-322
Dynamic Meteorology	Mr-323
Meteorological Charts and Diagrams	Mr-402
Physical Meteorology and Physical Oceanography	Mr-403

Wave, Swell and Surf Forecasting	Mr-404
Instruments	Mr-410
Thermodynamics of Meteorology	Mr-411
Physical Meteorology	Mr-412
Wave, Swell and Surf Forecasting	Mr-420
The Upper Atmosphere	Mr-422
Climatology	Mr-510
Seminar	Mr-810
Thesis I	Mr-921
Thesis II	Mr-922

METEOROLOGY (Principles of Meteorology) 2-0 Mr-100

Objective: To give the student officers, of the School of the Line, an understanding of the general principles of meteorology upon which forecasting is based in order that intelligent use can be made of weather information available to ships at sea, and to aid in the preparation of weather reports in compliance with current instructions.

Description: This course covers the general principles of meteorology, including cloud forms, structure of the atmosphere, wind and pressure relationships, air masses and fronts, general and secondary circulations of the atmosphere, weather phenomena associated with stability and instability, such as clouds, thunderstorms and fog.

The applications of the above principles are used with weather map reading, and weather map analysis. Lectures are supplemented by motion pictures and exercises in drawing a series of simple weather maps.

Prerequisites: None.

METEOROLOGY (Fundamentals of Atmospheric Circulation) 3-0 Mr-101

Objective: To provide the student officers a comprehensive survey of the basic principles of atmospheric circulation.

Description: This course serves as an introductory course in Meteorology, especially as it concerns large- and small-scale circulations, and the variations of these with height. It is designed primarily to give student officers in related subjects the required meteorological backgrounds, and, at the same time, to outline possible inter-relationships between the subjects.

Prerequisites: None.

METEOROLOGY (Radiological Defense) 2-0 Mr-110

Objective: To provide an understanding of the possibilities and limitations of atomic weapons and indoctrination in the subject of Radiological Defense.

Description: This course is devoted to discussions of explosion phenomena, the effects of blast and radiation, the aerological problem of fall-out, decontamination, and organization and training for Radiological Defense.

Prerequisites: Ph-190; Mr-302 for MA group.
Mr-323 for M2 group.

METEOROLOGY (Introduction to Synoptic Meteorology) 3-0 Mr-200

Objective: To provide the student officers a comprehensive survey of the basic principles of modern meteorology in an elementary form.

Description: This course serves as a preparation for advanced study of synoptic meteorology. It is primarily an introduction to synoptic meteorology as a survey course, considering in turn the composition of the atmosphere, general circulation, air masses and air-mass changes, fronts, cyclones and anti cyclones, weather analysis and weather forecasting.

Prerequisites: None.

METEOROLOGY (Weather Maps and Codes) 2-12 Mr-201

Objective: To impart to the student officers the current methods of obtaining, exchanging and preparing the meteorological data required in weather analysis and forecasting.

Description: This course is concerned with the problems of observing, transmitting, and preparing for analysis the facts of the state of the atmosphere. It therefore considers the methods, instruments, and conventions used in observing; the reduction of the observed facts into short coded messages; and the decoding and plotting of the data on the standard charts used for weather analysis. A series of lectures and motion pictures is presented to give the student officers an outline of the principles of meteorology. Finally, the students analyze an idealized and a three-hourly series of weather maps.

Prerequisites: None.

METEOROLOGY (Surface Weather Map Analysis and Forecasting) 2-12 Mr-202

Objective: To impart to the student officers the fundamental elements of surface weather map analysis; a knowledge of upper-wind charts; and the elementary principles of weather forecasting associated therewith.

Description: The principles of surface weather map analysis are demonstrated by having the students analyze current daily weather charts; correlate upper wind data with the surface charts; observe the local surface weather elements; discuss the map analysis; and make trial forecasts.

Prerequisites: Mr-200; Mr-201.

METEOROLOGY (Weather Analysis and Forecasting) 2-12 Mr-203

Objective: To provide the student officers with techniques for application of the fundamentals of air-mass and frontal analysis to weather map analysis and forecasting.

Description: This course is a continuation of course Mr-202. More advanced methods of current weather map analysis and forecasting are presented; and emphasis is placed on the application of analysis and forecast techniques previously presented in the theoretical courses. The students are taught the usefulness of upper air observations in determining air-mass characteristics, movements, etc. Daily forcasts and map discussions are included.

Prerequisites: Mr-202; Mr-301; Mr-402.

METEOROLOGY (Advanced Weather Analysis and Forecasting) 0-15 Mr-204

Objective: To present the techniques of the latest methods of weather analysis; and the application of those methods to modern weather forecasting.

Decription: This course is a continuation of course Mr-203. The student officers are taught to analyze and forecast the weather in accordance with the most advanced applied methods, using all available sources of information, including the surface maps, upper-level charts, wind-aloft data, and meteorograph and radiosonde observations. The course is coordinated with course Mr-205, wherin the upper level charts are drawn, and differential analysis, cross-sections and prognostic charts are prepared. In addition, the students are required to analyze special weather sequences for selected localities of the world.

Prerequisites: Mr-203; Mr-302; Mr-403.

METEOROLOGY (Upper Air Analysis) 0-10 Mr-205

Objective: To give the student a thorough understanding of the three dimensional nature of weather processes and practice in the application of the latest forecasting techniques, using upper-air data.

Description: The course is devoted entirely to upper-air analysis (supplemented by surface map analysis in Mr-204) including constant-pressure analysis, cross-sections, etc.

Prerequisites: Mr-302; Mr-203; Mr-403.

METEOROLOGY (Introduction to Synoptic Meteorology) 5-0 Mr-210

Objective: To provide the students with a comprehensive survey of the meteorological elements and their utilization in synoptic map analysis and forecasting.

Description: This course is a survey of synoptic meteorology, designed to serve as a preparation for study of the various topics considered in the several subsequent advanced courses in meteorology, and as a preparation for laboratory study of weather map analysis and forecasting. It studies successively the distribution of insolation and atmospheric and terrestial temperature, the general circulation of the atmosphere, and the major aspects of the air-mass and frontal systems of weather analysis.

Prerequisites: None.

METEOROLOGY (Weather Maps and Codes) 2-9 Mr-211

Objective: To instruct the student officers in the current methods of obtaining, exchanging and preparing the meteorological data required in weather analysis and forecasting.

Description: This course is concerned with the problems of observing. transmitting, and preparing for analysis the facts of the state of the atmosphere. It therefore considers the methods, instruments, and conventions used in observing and the reduction of the observed facts into short coded messages; the decoding and plotting of the data on the standard charts used for weather analysis. A series of lectures and motion pictures is presented to give the student officers an outline of the principles of meteorology.

Prerequisites: None.

METEOROLOGY (Surface Weather Map Analysis) 1-12 Mr-212

Objective: To impart to the student officers the rudiments of surface weather map analysis, a knowledge of upper-wind charts, and some elementary principles of weather forecasting.

Description: The first principles of surface weather map analysis are demonstrated by having the students analyze an idealized series of weather maps based upon weather observations in the United States. This series is accompanied by a written discussion of each map, giving the criteria to be applied for acceptable analysis. A sequence of maps, at three-hourly intervals, is next analyzed in order to develop concepts of historical sequence and movements of systems. This concerns data for North America and the Eastern and Western approaches thereto. The last half of the course is devoted to daily analysis of the current weather charts, including ocean areas; correlation of upper winds with the surface data; practical observations of local weather elements; group discussions of the map analyses; and trial forecasting.

Prerequisite: Mr-211.

METEOROLOGY (Map Analysis and Forecasting) 0-9 Mr-213

Objective: To instruct the student in additional principles of weather map analyses and forecasting, particularly as concerns the first fundamentals of air-mass and frontal analysis.

Description: This course is a continuation of Course Mr-212. More advanced methods of current weather map analysis and forecasting are presented. The air-mass and frontal concepts are stressed, and the application of analysis and forecast techniques previously presented in the theoretical Course Mr-210 are brought out.

Prerequisites: Mr-212; Mr-210.

METEOROLOGY (Weather Analysis and Forecasting) 2-9 Mr-214

Objective: To give the student an insight into the correlation of the upper-air observations with the surface map analysis; and introduce additional advanced analysis and forecasting techniques.

Description: This is a continuation of Course Mr-213. The students are taught the usefulness of upper-air observations in determining air-mass characteristics, movements, etc.; and the correlation of these observations with the surface map analysis and the forecasts. This, together with additional surface analysis techniques and practical applications of the Technical Course Mr-321, introduces the students to three-dimensional weather analysis. Map discussions and practice forecasting are continued.

Prerequisites: Mr-213; Mr-411.

METEOROLOGY (Weather Analysis and Forecasting) 1-9 Mr-221

Objective: To give the students a practical working knowledge of three-dimensional weather analysis and forecasting.

Description: This course continues the instruction given in Course Mr-214. The students are required to become familiar with upper-level charts, and prepare surface prognostic charts. These are correlated with the surface map analysis to give a three-dimensional analysis. The weather analysis discussions and forecasts are continued.

Prerequisites: Mr-214; Mr-321; Mr-412.

METEOROLOGY (Weather Analysis and Forecasting) 0-12 Mr-222

Objective: To continue the instruction commenced in Course Mr-221.

Description: A continuation of Course Mr-221.

Prerequisites: Mr-221; Mr-322.

METEOROLOGY (Advanced Weather Analysis and Forecasting) 0-9 Mr-223

Objective: To continue the instruction commenced in Course Mr-222.

Description: A continuation of Course Mr-222.

Prerequisites: Mr-222; Mr-229; Mr-323.

METEOROLOGY (Advanced Weather Analysis and Forecasting) 0-15 Mr-224

Objective: To present the techniques of the latest methods of weather analysis, and the applications of these methods to modern weather forecasting.

Description: This course is a continuation of Course Mr-223. The student officers are taught to analyze and forecast the weather in accordance with the most advanced methods, using all available sources of information, including the surface maps, local conditions, upper-level charts, winds aloft, and meterograph and radiosonde observations. The practical aspects of Course Mr-220 are demonstrated and the course is coordinated with Course Mr-225 wherein the upper-level charts are drawn, and differential analyses, cross-sections and prognostic charts are prepared. In addition, the students are required to analyze special weather sequences for selected localities of the world.

Prerequisite: Mr-223.

METEOROLOGY (Upper-Air Analysis) 0-10 Mr-225

Objective: To give the student a thorough understanding of the three-dimensional nature of weather processes and practice in the application of the latest forecasting techniques, using upper-air data.

Description: The course is devoted entirely to upper-air analysis (supplemented by surface map analysis in Mr-224) including constant-pressure analysis, cross-sections, etc.

Prerequisite: Mr-223.

METEOROLOGY (Southern Hemisphere and Tropical Meteorology) 2-0 Mr-228

Objective: To provide the student officers with an introduction to the synoptic meteorology of the Southern Hemisphere and the Tropics.

Description: The course consists of lectures and reading assignments dealing with the synoptic aspects of Southern Hemisphere meteorology, tropical synoptic models (with particular emphasis on the tropical cyclone), and tropical forecasting.

Prerequisites: Mr-321; Mr-214.

METEOROLOGY (Selected Topics in Applied Meteorology) 2-0 Mr-229

Objective: To review and extend forecasting techniques based on latest current practice.

Description: The course consists of lectures and reading assignments dealing with isentropic analysis, single-station forecasting, long-range forecasting, and any important recent developments in meteorological practice.

Prerequisites: Mr-221; Mr-322.

METEOROLOGY (Synoptic Meteorology) 5-0 Mr-301

Objective: To provide the student officers with a background of those fundamental concepts of theoretical meteorology which are of immediate application to the analysis of weather charts and to forecasting weather.

Description: This course deals with the fundamental theoretical concepts of Synoptic Meteorology, covering air-mas and frontal characteristics, stability and instability, wind and pressure systems, movement and development (or dissipation) of fronts and pressure systems, with applications to weather forecasting.

Prerequisites: Mr-200; Ph-190; Ma-161.

METEOROLOGY (Synoptic Meteorology) 5-0 Mr-302

Objective: To provide the student officers with the theory and technique necessary to the formulation of a complete three dimensional picture of the state of the atmosphere, and the application to the forecasting of weather in any part of the world.

Description: This course covers the theory and use of constant-pressure charts, cross-sections, differential analysis, and their relation to the surface chart and to forecasting. Local features of the meteorological and climatological conditions in polar, middle and tropical latitudes of both hemispheres are surveyed insofar as data are available.

Prerequisites: Mr-301; Mr-402; Ma-162.

METEOROLOGY (Dynamic Meteorology I) 3-0 Mr-321

Objective: To provide the student officers with the theoretical background necessary to understand the physical behavior of the atmosphere and its motions.

Description: The course consists of lectures and concurrent reading assignments from the texts on the following topics: scalar and vector fields; surfaces of discontinuity; solenoids and the Circulation Theorems; tertiary circulations; secondary circulations of thermal and dynamic types; streamlines and trajectories; hydrostatics and the thermal wind; stability, convection and subsidence.

Prerequisites: Mr-411; Mr-210; Ph-196; Ma-103.

METEOROLOGY (Dynamic Meteorology II) 3-0 Mr-322

Objective: To provide the student officers with the theoretical background necessary to understand the physical behavior of the atmosphere and its motions.

Description: The course is a continuation of Mr-321, covering the following topics: continuity and tendency equations; convergence and divergence; vorticity; frontogenesis and frontolysis; stability, convection and subsidence; the General Circulation and its influence on the formation of air masses.

Prerequisites: Mr-321; Ma-134.

METEOROLOGY (Dynamic Meteorology III) 3-0 Mr-323

Objective: To provide the student officers with the theoretical background necessary to understand the physical behavior of the atmosphere and its motions, particularly in the friction layer.

Description: This course is a continuation of Mr-322 and considers the following topics: general effects of viscosity; equations of motion for laminar and turbulent flow; dynamic similarity; wind variation in the surface layer; energy changes in wind system; transfer of air properties by turbulent mass exchange; diurnal temperature variations; transformation of air masses.

Prerequisites: Mr-322; Ma-135.

METEOROLOGY (Meteorological Charts and Diagrams) 3-0 Mr-402

Objective: To give the student officers an understanding of the origin and development of thermodynamic diagrams and charts used in current meteorological practice; and to give him extensive practice in the techniques of their use.

Description: The course proceeds from an elementary discussion of the gas laws and the physics of change of state and phase, to their graphical representation on the psuedo-adiabatic diagram, and to techniques of analysis for stability and instability in weather forecasting.

Prerequisites: Ph-190; Ma-161.

METEOROLOGY (Physical Meteorology and Physical Oceanography) 4-0 Mr-403

Objective: To provide the student officers with the elements of radiation, turbulence, and oceanography necessary for the practical forecasting of conditions for stratus and fog, radar efficiency, and defensive uses of gas and smokes.

Description: The course proceeds from elementary physical and mathematical discussions to the numerical solution of problems and to practice forecasts in radiation and turbulence for naval operations.

Prerequisites: Ph-190; Ma-162.

METEOROLOGY (Wave, Swell and Surf Forecasting) 0-2 Mr-404

Objective: To prepare the student officers to comply with current directives regarding wave, swell and surf forecasting; that is, to learn to forecast wave, swell and surf for naval operations.

Description: The student officers are required to solve problems from the texts and make practice forecasts.

Prerequisite: Ph-190.

METEOROLOGY (Instruments) 2-2 Mr-410

Objective: To acquaint the student officer with the theory of design, construction, and use of meteorological instruments.

Description: Standard naval meteorological instruments are studied and used by the student. Additional instrumentation peculiar to (1) cold climates, (2) very high elevations, and (3) micrometeorological elements is investigated generally. Special attention is paid to errors and to reliability of observation.

Prerequisite: Ph-196 or Ph-190.

METEOROLOGY (Thermodynamics of Meteorology) 5-2 Mr-411

Objective: To provide the student officers with an understanding of the principles and analyses of meteorological thermodynamics and atmospheric statics.

Description: This course considers the following topics: the physical variables; first and second laws of thermodynamics; concept of entropy; equation of state; properties of gases; properties of water and moist air; thermodynamic diagrams; air mass identification indices; geopotential determinations; stability criteria.

Prerequisites: Mr-210; Ma-102; Ph-196.

METEOROLOGY (Physical Meteorology) 3-0 Mr-412

Objective: To provide a treatment of radiation and optical phenomena in meteorology.

Description: This course deals with (1) solar and terrestrial radiation, and (2) the physics of atmospheric phenomena in which optical or scattering effects are produced by clouds, fogs, raindrops, haze, etc.

Prerequisites: Ph-196; Mr-411; Ma-103.

METEOROLOGY (Wave, Swell and Surf Forecasting) 2-1 Mr-420

Objective: To provide the student with the basic theory of surface water waves and the methods of forecasting sea, swell, surf and associated phenomena.

Description: This course considers the following topics: the characteristics of surface water waves; generation of waves; methods of forecasting sea and swell; methods of forecasting breakers and surf conditions; under water depth determinations; and methods of locating rubber rafts adrift at sea.

Prerequisites: Mr-322; Ma-135.

METEOROLOGY (The Upper Atmosphere) 4-1 Mr-422

Objective: To study the physics of the atmosphere at upper levels.

Description: A study of selected topics in Physics which lead to an understanding of the physical structure of the high atmosphere. These topics will be selected from (1) sound, (2) kinetic theory, (3) electromagnetic theory, and (4) atomic structure and spectroscopy. Using these tools, the various stratospheric layers are analyzed in order to determine the variation of composition and of the meteorological elements with height.

Prerequisites: Mr-323; Mr-412.

METEOROLOGY (Climatology) 2-0 Mr-510

Objective: To survey dominant aspects of world weather and climate.

Description: This course considers the major continental and oceanic regions of the world with respect to their dominant weather characteristics and covers the meteorological and oceanographic processes that are important in the development of these characteristics.

Prerequisites: Mr-212; Mr-210.

METEOROLOGY (Seminar) 2-0 Mr-810

Objective: To give the students a rapid survey of the current literature concerning the advance of the meteorological science subsequent to the various texts already studied.

Description: Students study and prepare synopses of current publications and original data, concerning meteorology, and present them for group discussion.

Prerequisite: Mr-229.

METEOROLOGY (Thesis I) 2-0 Mr-921

Objective: To instruct the student officers in the techniques of research and to start them on actual research problems in meteorology.

Description: Students are expected to begin research on problems selected by themselves or assigned to them. Each student will be directed and assisted in his work by a staff member qualified in the special field of the problem selected.

Prerequisites: Mr-229; Mr-323; Ma-331.

METEOROLOGY (Thesis II) 4-0 Mr-922

Objective: To complete the work begun in Mr-921.

Description: This course is a continuation of Mr-921. The work begun in Mr-921 will be completed and prepared in proper form for presentation to the Academic Council and/or for publication.

Prerequisites: Mr-921; Mr-422.

METALLURGY

Mt Courses

Production Metallurgy	Mt-101
Production of Steel	Mt-102
Production of Non-Ferrous Metals	Mt-103
Introduction to Physical Metallurgy	Mt-201
Ferrous Physical Metallurgy	Mt-202
Physical Metallurgy	Mt-203
Physical Metallurgy	Mt-204
Advanced Physical Metallurgy	Mt-205
Advanced Physical Metallurgy	Mt-206
Metals	Mt-211
Metals	Mt-212
High Temperature Materials	Mt-301
Alloy Steels	Mt-302
Metals Seminar	Mt-303
Physics of Metals	Mt-401

METALS (Production Metallurgy) 2-0 Mt-101

Objective: To present the principles involved in extraction of metals from their ores. To supply general background material for subsequent courses in the subject.

Description: This course serves as an introduction to the study of metallurgy and is essentially descriptive in nature. Subjects treated include, the occurrence and classification of metal bearing raw materials; the fundamental processes of extractive metallurgy; refractories, fuels, fluxes slags and equipment; a brief summary of steel making and the production of copper and zinc.

Prerequisite: Ch-101.

METALS (Production of Steel) 3-0 Mt-102

Objective: To present the fundamental principles involved in the production of iron and steel. A course to supply basic concepts necessary for advanced physical metallurgy subjects.

Description: The subject matter includes such topics as the occurrence and composition of various iron ores, the blast furnace, its design and operation, blast furnace products. The various methods of steel production and the production of grey, white and malleable cast iron.

Prerequisites: Ch-101 or Ch-121, Mt-101.

METALS (Production of Non-Ferrous Metals) 3-0 Mt-103

Objective: To present the fundamental principles involved in the production of the important non-ferrous metals. A course that supplies basic concepts for advanced physical metallurgy courses.

Description: The subject matter includes a discussion of the sources, the strategic importance of and the production of the following metals: copper, zinc, lead, tin, aluminum, magnesium, and several minor metals.

Prerequisites: Ch-101 or Ch-121, Mt-101.

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METALS (Introductory Physical Metallurgy) 3-2 Mt-201

Objective: To give the student the necessary background in physical metallurgy for an understanding of the nature of metals and alloys and to assist in answering various problems involving these materials encountered in the naval service. This course also supplies prerequisites in the subject for other engineering courses.

Description: This course serves as an introduction to physical metallurgy. Subjects treated include (a) the nature, characteristics and properties of metals, (b) the application of the phase rule to binary and ternary alloy systems and characteristic phase diagrams, (c) the correlation of microstructure, mechanical properties and corrosion resistance of alloys with phase diagrams, (d) mechanical deformation and heat treatment of alloys, and (e) descriptions of representative non-ferrous alloys of commercial importance. The subject matter is illustrated by reference to technically important alloy systems in which the phenomena are commonly observed.

The laboratory experiments are designed to introduce to the student the methods available to the metallurgist for the study of metals and alloys. These include the construction of equilibrium diagrams and metallographic studies of fundamental structures, brass, bronze, bearings, etc.

Prerequisite: None.

METALS (Ferrous Physical Metallurgy) 3-2 Mt-202

Objective: To give the students the necessary background in physical metallurgy for an understanding of the nature of metals, and alloys, and to assist in answering various problems involving these materials and encountered in the naval service. This course also supplies prerequisites for other engineering courses.

Description: This course continues the presentation of subject matter introduced in Metals, Mt-201, with emphasis on the alloys of iron. Subjects treated include (a) the alloys, (b) effects of various heat treatments and cooling rates on the structure and properties of steel, (c) isothermal reaction rates and the hardenability of steel, (d) surface hardening methods, (e) characteristics and properties of plain carbon and alloy cast irons, (f) the effect of other alloying elements on steel, (g) tool steels, (h) corrosion and corrosion resisting steels.

The laboratory work includes experiments in the heat treatment of steel, mechanical testing and metallegraphic examination of common ferrous alloys.

Prerequisite: Mt-201.

METALS (Physical Metallurgy) 2-2 Mt-203

Objective: This course is designed to give the students a knowledge of the properties of metals and alloys.

Description: The subject matter is in part a continuation of that presented in Mt-201 and Mt-202. It includes a discussion of fatigue and fatigue failures, foundry metallurgy and the metallurgy of welding. Consideration is given to developments in powder metallurgy and to the behavior of metals at elevated temperatures. A summary is made on the basis of this and the other metallurgy courses of the causes of defects and failures in metals. Approximately one third of the course is concerned with a study of the alloys of aluminum and magnesium.

Prerequisites: Mt-201, Mt-202.

METALS (Physical Metallurgy) 3-4 Mt-204

Objective: This course is designed to supply certain prerequisites to special students for graduate work in metallurgy at a civilian university.

Description: The material presented in this course includes a study of phase transformations in steel, isothermal decomposition reactions and products, decomposition on continuous cooling, factors involved in hardenability and methods of evaluating it; time, temperature, transformation curves. Heat treatment of steel, alloy steels, high strength cast irons and cast steels.

Prerequisites: Mt-201, Mt-202.

METALS (Advanced Physical Metallurgy) 3-4 Mt-205

Objective: This course is designed to give the student advanced training in physical metallurgy and to have him acquire an appreciation of the problems and methods employed in the subject, and to supply the necessary background for graduate work at a civilian university.

Description: The subject matter includes such topics as electron theory of metals, the structure of metals and alloys, phase diagrams, types of solid solutions, phase transformations superlaltices, etc.

The laboratory work is intended to insure proficiency in the usual metallurgical laboratory techniques including optical and X-Ray methods, pyrometry, controls, furnaces, etc.

Prerequisite: Mt-204.

METALS (Advanced Physical Metallurgy) 3-2 Mt-206

Objective: This course is designed to give the student advanced training in physical metallurgy, to have him acquire an appreciation of the problems and methods employed in the subject and to supply the necessary background for graduate work at a civilian university.

Description: The subject matter of this course is an extension of that offered in Mt-205 and includes such topics as plastic deformation, theories of slip, structure of deformed metal, recrystallization, preferred orientation, etc.

Prerequisite: Mt-205.

METALS 4-2 Mt-211

Objective: The objective of this course is to give the students a knowledge of the methods used in the extraction of metals from their ores and a knowledge of the principles necessary for an appreciation of the properties, heat treatment and applications of metals and alloys.

Description: This course, in conjunction with Metals, Mt-212, is designed to include some of the material offered in Metals, Mt-101, Mt-201, and Mt-202. The methods of iron and steel production are discussed and detailed consideration is given to: the nature of metals, the properties of crystals, equilibrium diagrams, changes in the solid state, the effect of mechanical work on the structure and properties, the metallography, heat treatment, properties of the brasses, bronzes, bearings, light alloys and other important non-ferrous alloys.

The laboratory experiments include: a study of fundamental structures; a microscopic examination of brasses, bronzes, bearings, light alloys, etc.

Prerequisites: None.

METALS 4-2 Mt-212

Objective: The objective of this course is to give the students a knowledge of the methods used in the extraction of metals from their ores and a knowledge of the principles necessary for an appreciation of the properties, heat treatment and applications of metals and alloys.

Description: This course in conjunction with Mt-211 is designed to include some of the material offered in Mt-101, Mt-201 and Mt-202. The methods of extracting copper, lead, zinc and some of the minor metals are considered. Physical metallurgy topics include the metallography, heat treatment, properties and applications of the plain carbon and alloy steels, cast irons, and the metallurgical aspects of corrosion.

Prerequisite: Mt-211.

METALS (High Temperature Materials) 3-0 Mt-301

Objective: The objective of this course is to supply the essential background for an appreciation of the requirements necessary in materials to be used at elevated temperatures.

Description: This course includes a study of the methods used in evaluating the probable behavior of materials at elevated temperatures, a consideration of the properties of particular importance in such service; evaluation of present heat resisting alloys; a study of high temperature behavior of alloys used in gas turbines, jets, and rocket motors. A study of ceramics as possible materials for high temperature service is included.

Prerequisites: Mt-201, Mt-202.

METALS (Alloy Steels) 4-2 Mt-302

Objective: The purpose of this course is to supply to naval officers specializing in the study of metallurgy a knowledge of the characteristics of modern alloy steels.

Description: The subject matter includes a study of the properties of alloy steels, the effect of alloying elements on the structure properties and heat treatment. A detailed consideration is given to tool, die, heat resisting and stainless steels and to high strength and alloy cast irons.

Prerequisite: Mt-202.

METALS (Metals Seminar) 1-0 Mt-303

Objective: To bring to the attention of the student the progress or results of current metallurgical researches and technical developments.

Description: Papers from current technical journals will be reported and discussed by students.

Prerequisites: None.

METALS (Physics of Metals) 2-2 Mt-401

Objective: To introduce the student to modern theories of the solid state in order that he may appreciate the significance of current theoretical and experimental investigations and to prepare him for advanced work in metallurgy at a civilian university.

Description: The course will cover the elements of crystal chemistry, the ionic bond, the co-valent bond, the metallic bond, the development of quantum theory, the Fermi-Dirac statistics and the bond theory. Such types as specific heats, magnetic properties, phase equilibria, the liquid state, semi-conductors, superconductors and low temperature phenomena, thermionic and optical properties will be discussed as time and the interest of the class allow and will serve as the basis of short research problems.

Prerequisites: None.

MARINE ENGINEERING

NE Courses

Main Propulsion	NE-101
Auxiliary Machinery	NE-102
Engineering Department Organization	NE-103

MARINE ENGINEERING (Main Propulsion) 3-0 NE-101

Objective: To give the student officer of the Naval Engineering Groups a knowledge of the capabilities and limitations of naval steam-turbine-reduction-gear propulsion and machinery and its auxiliaries, and a knowledge of the best engineering practice in connection with maintenance and operation therof.

Description: This course is a study of steam-turbine-reduction-gear propulsion plants and their auxiliaries. Subjects treated include: boilers, theory of combustion, forced draft blowers, fuel oil and fuel oil equipment, boiler feedwater systems, piping and valves, gaskets and packing, pumps and governors, main turbines, condensers and air ejectors, reduction gears, bearings and shafting, propellors, lubrication and lubricants, and BuShips Bulletins of Information and BuShips Circular Letters pertinent to the above.

Prerequisites: None.

MARINE ENGINEERING (Auxiliary Machinery) NE-102

Objective: To give the student officer of the Naval Engineering Groups a knowledge of the capabilities and limitations of naval auxiliary machinery and of the best engineering practice in connection with the maintenance and operation thereof.

Description: This course is a study of naval machinery other than main propulsion machinery. Subjects treated include: auxiliary turbines, mechanical measuring instruments, hydraulic speed gears, steering gear, diesel (auxiliary) engines, compressed air plants, welding and cutting, distilling plants, refrigeration plants, electrical plant (general), generators and voltage regulators, electrical distribution systems, storage batteries, motors and controllers, lighting, interior communication systems, searchlights, electrical measuring instruments, and BuShips Bulletins of Information and BuShips Circular Letters pertinent to the above.

Prerequisite: NE-101.

MARINE ENGINEERING (Engineering Department Organization) 1-0 NE-103

Objective: To acquaint the student officer with the administrative duties of the engineering officer afloat.

Description: The topics discussed here are those not included elsewhere in the curriculum. These include: Engineering Department Organization, Routine Tests and Inspections Machinery Index, Machinery History, Current Ship's Maintenance Project, Ship's Force Overhauls, Tender Overhauls, Navy Shipyear Overhauls, Supplies, Spare Parts, Requisitions, Engineering Casualty Control, Safety Precautions, Engineering Competition, and Economical Operation of Engineering Plants.

Prerequisites: None.

ORDNANCE and GUNNERY

Or Courses

Ordnance Administration and Special Equipage	Or-103
Surface Fire Control	Or-205
Anti-Aircraft Fire Control	Or-304
Anti-Aircraft Fire Control	Or-305
Guided Missile Guidance	Or-404
Guided Missile Guidance	Or-405
Underwater Ordnance	Or-501
Mine Design	Or-503

NEW WEAPON DEVELOPMENT

SL Lecture Courses

New Weapon Development I	SL-101
New Weapon Development II	SL-102

ORDNANCE AND GUNNERY (Ordnance Administration and Special Equipage) 2-0 Or-103

Objective: To give the student officer an understanding of the Organization of the Bureau of Ordnance and its administration of the manufacture, supply and storage of ordnance material. To familiarize the student with the duties and responsibilities of a gunnery officer afloat.

Description: Organization and administration of the Bureau of Ordnance, powder, explosives, fuses, ammunition, elementary theory and construction of rockets, basic gun design, duties of the gunnery officer.

Prerequisites: None.

ORDNANCE AND GUNNERY (Surface Fire Control) 2-0 Or-205

Objective: To familiarize the student with the principles of surface fire control and their application to instruments and systems aboard ship in order to provide a foundation for advanced study of fire control instruments of current and new design used in surface gunnery.

Description: (This course is to follow an introductory course covering an analytical solution of the fire control problem, basic mechanisms, rangekeeper and computer theory). Fundamentals of the surface fire control problem, rangekeeper theory, director systems, synchros, fire control errors and correctors, battery alignment.

Prerequisite: Or-304 (or equivalent).

ORDNANCE AND GUNNERY (Anti-Aircraft Fire Control) 0-3 Or-304

Objective: To familiarize the student with the analytical solution of the Anti-Aircraft problem and the basic theory of one conventional anti-aircraft system.

Description: Lecture Series: Fundamentals of the anti-aircraft fire control problem, analytical solution of the anti-aircraft fire control problem, basic mechanisms, rangekeeper and computer theory, units making up one anti-aircraft fire control system, introduction to fire control errors and correctors.

Prerequisite: Or-205.

ORDNANCE AND GUNNERY (Anti-Aircraft Fire Control) 2-0 Or-305

Objective: To familiarize the student with the anti-aircraft problem and the equipment utilized in its solution.

Description: Review of the fundamentals of the anti-aircraft fire control problem, theory of gyro lead computing systems, basic electro-mechanical computing equipment.

Prerequisite: Or-304 (or equivalent).

ORDNANCE AND GUNNERY (Guided Missile Guidance) 2-0 Or-404

Objective: To present the guided missile problem as an advanced fire control problem with particular emphasis on the guidance features.

Description: Continuation of the basic surface to air fire control problem, introduction to guided missiles and guidance systems.

Prerequisite: Or-304 (or equivalent).

ORDNANCE AND GUNNERY (Guided Missile Guidance) 1-0 Or-405

Objective: To present the guided missile problem as an advanced fire control problem with particular emphasis on the guidance features.

Description: This course is a continuation of Or-404, and consists of a survey of guidance systems and guided missiles.

Prerequisites: Or-304 (or equivalent) Or-404.

ORDNANCE AND GUNNERY (Underwater Ordnance) 2-0 Or-501

Objective: To familiarize the student officer with the ordnance of depth charges, mines, torpedoes, nets and booms.

Description: Moored and ground mines, contact and influence firing mechanisms, depth charges and other antisubmarine ordnance, steam, electric and chemical torpedoes, theory and design of torpedo control equipment, harbor defense, nets and booms.

Prerequisites: None.

ORDNANCE AND GUNNERY (Mine Design) 2-0 Or-503

Objective: To give the student officer a thorough knowledge of the latest design features of mines, contact and influence mine sweeping, nets and booms.

Description: Mathematical aspects of minefield planning, detailed design of influence firing mechanisms, design of mine accessories, moored and ground mine sweeping and location, harbor defense.

Prerequisites: None.

NEW WEAPON DEVELOPMENT I 0-1 SL-101

(Lecture)

Objective: To familiarize the student officer with the factors affecting fundamental and applied research and to develop a general appreciation of the effect of new developments on naval operations as regards both unit design and general employment.

Description: This course consists of the first ten (10) lectures of a twenty (20) lecture series to be delivered by authorities in the field of New Weapon Development, the latter term being used in its broadest sense and including such developments as atomic energy, guided missiles, pilotless aircraft, radar, special communication equipment, countermeasures, special fuzes, and jet propulsion.

Prerequisites: None.

NEW WEAPON DEVELOPMENT II 0-1 SL-102

(Lecture)

Objective: Same as for SL-101.

Description: This course is a continuation of Course SL-101 and consists of the second ten (10) lectures of the twenty (20) lecture series described under SL-101.

Prerequisites: None.

Ph Courses

Dynamics and Heat	Ph-113
Dynamics	Ph-140
Mechanics	Ph-153
Introduction to Physics (Meteorology)	Ph-190
General Physics (Meteorology)	Ph-196
Geometrical and Physical Optics	Ph-210
Optics	Ph-211
Physical Optics and Introductory Dynamics	Ph-212
Optics and Optical Spectra	Ph-240
Electricity	Ph-311
Electricity and Magnetism	Ph-341
Electronics	Ph-342
Electronics and Radiation Measurements	Ph-343
Electromagnetism	Ph-361
Electromagnetic Waves	Ph-362
Sound	Ph-410
Sound	Ph-421
Sound	Ph-422
Sound	Ph-423
Sonar Systems	Ph-424
Kinetic Theory	Ph-540
Atomic Physics	Ph-610
Modern Physics	Ph-631
Atomic Physics	Ph-640
Theoretical Physics	Ph-731
Theoretical Physics	Ph-732

PHYSICS (Dynamics and Heat) 3-0 Ph-113

Objective: To continue the study of dynamics begun in Ph-212 so as to provide a knowledge of dynamics as applied to the various fields of physics.

Description: Kinematical and dynamical motions of a particle and of rigid bodies, energy concepts in dynamics, constrained motion, equations of Lagrange and of Hamilton, oscillations of a dynamical system, kinetic theory, introductory thermodynamics. Both analytical and vector methods are used.

Prerequisites: Ma-102; Ph-212.

PHYSICS (Dynamics) 4-0 Ph-140

Objective: To provide a knowledge of the fundamental principles of dynamics as applied to the various fields of physics and in particular to atomic mechanics.

Description: Fundamental dynamical concepts, curvilinear motion in a plane, energy concepts in dynamics, statics and dynamics of a rigid body, constrained motion, D'Alembert's principle, equations of Lagrange and of Hamilton, oscillations of a dynamical system. Both analytical and vector methods are used.

Prerequisite: Ma-182.

PHYSICS (Mechanics) 3-0 Ph-153

Objective: To continue the study of mechanics begun in physics 252 so as to provide a knowledge of the principles of mechanics most frequently employed in the various fields of physics.

Description: Statics of a particle, statics and dynamics of a rigid body, constrained motion, oscillations, equations of Lagrange and Hamilton, kinetic theory, deformable bodies, and wave motion. Both analytic and vector methods are used.

Prerequisite: Ph-212.

PHYSICS (Introduction to Physics (Meteorology)) 3-0 Ph-190

Objective: To acquaint the student officer with the practical elements of mechanics, wave motion, and heat, that will be of immediate applicability in later courses in Meteorology.

Description: The course covers mechanics, wave motion, and heat, by lecture, reading assignments, and solution of simple numerical problems.

Prerequisites: None.

PHYSICS (General Physics (Meterology)) 5-1 Ph-196

Objective: To provide and extensive review of basis physics preparatory to the study of physical meterology.

Description: The course is a survey of the mechanics of solids and fluids, heat and kinetic theory, and wave motion.

Prerequisites: None.

PHYSICS (Geometrical and Physical Optics) 3-0 Ph-210

Objective: To familiarize the student with the principles of geometrical and physical optics, and to provide an introduction to spectroscopy.

Description: The following topics are included: reflection and refraction of light, lenses and lens systems, dispersion, interference, diffraction, polarization, and optical spectra.

Prerequisites: None.

PHYSICS (Optics) 3-0 Ph-211

Objective: To familiarize the student with the principles of geometrical optics and to provide an introduction to physical optics.

Description: Reflection and refraction of light, lenses and lens aberrations, stops, optical systems, and dispersion.

Prerequisites: None.

PHYSICS (Physical Optics and Introductory Dynamics) 3-3 Ph-212

Objective: To familiarize the student with the principles and phenomena of physical optics and to provide an introduction to dynamics.

Description: An analytical presentation of interference, diffraction, polarization, origin of spectra, fluorescence and phosphorescence, with applications to infra-red signalling, optical behavior of radio waves, introductory dynamics. Related laboratory work is included.

Prerequisite: Ph-211.

PHYSICS (Optics and Optical Spectra) 3-3 Ph-240

Objective: To familiarize the student with the principles of geometrical and physical optics, and to provide an introduction to spectroscopy.

Description: The following topics are included: reflection and refraction of light, thin and thick lenses, optical systems, dispersion, interference, diffraction, polarization, and optical spectra.

Prerequisite: Ph-640.

PHYSICS (Electrostatics and Magnetostatics) 3-0 Ph-311

Objective: To present and develop the basic concepts of electrostatics, magnetostatics, and the production of magnetic fields by moving charges.

Description: Coulomb's law, Gauss' law, dipoles, dielectric theory, polarization, harmonic solutions of Laplace's equation, electrical images, magnetic dipoles and shells, Ampere's law, magnetic field of current, magnetic theory. Both analytical and vector methods are used.

Prerequisite: Ma-103.

PHYSICS (Electricity and Magnetism) 3-0 Ph-341

Objective: To study the basic laws of electricity and magnetism, and the interaction of electric and magnetic fields.

Description: Electrostatic fields and potentials, induced charges, capacity, steady electric currents, magnetic field of steady currents, induced electromotive forces, alternating currents, displacement currents, electromagnetic waves. The methods of vector analysis are employed.

Prerequisite: Ma-182. (may be taken concurrently)

PHYSICS (Electronics) 3-3 Ph-342

Objective: To acquaint the student with the fundamental concepts of vacuum tubes and their associated circuits.

Description: A, to a large extent, qualitative treatment of basic electronic circuits and instruments, including the study of emission phenomena, tube static characteristics, power rectifiers and filters, amplifiers, oscillators, modulators, detectors and the cathode ray oscilloscope and vacuum tube voltmeters.

Prerequisite: Ph-341.

PHYSICS (Electronics and Radiation Measurements) 3-3 Ph-343

Objective: To continue the objective of Physics 342 and to acquaint the student with the electronic instruments and techniques employed in measuring ionizing radiation.

Description: A study of pulse shaping, trigger circuits and multivibrators with emphasis on their application to counter circuits. A study of the phenomena of electrical discharge in gases and a study of the various instruments used in making radiation measurements.

Prerequisite: Ph-342.

PHYSICS (Electromagnetism) 3-0 Ph-361

Objective: To develop the basic laws of electromagnetism and their application to Maxwell's electromagnetic equations.

Description: Electromagnetic field theory; electrostatics; dielectrics; magnetic fields of currents; vector potential; magnetic materials; magnetomotive force; electromagnetic induction; Maxwell's equations; electromagnetic waves.

Prerequisite: Ma-103.

PHYSICS (Electromatic waves) 3-0 Ph-362

Objective: To continue the study of the application of Maxwell's electromagnetic equations.

Description: Reflection and refraction of electromatic waves; wave guides; cavity resonators; electromagnetic radiation.

Prerequisite: Ph-361.

PHYSICS (Sound) 3-0 Ph-410

Objective: To give the student officer a sufficient knowledge of the properties of sound to enable him to understand its military applications.

Description: This course provides a brief survey of vibrating systems, and of the problems arising in connection with the radiation, transmission and reception of sound in air and in water.

Prerequisite: Ma-102.

PHYSICS (Fundamental Acoustics) 3-0 Ph-421

Objective: To acquaint the student with the fundamental theory of vibrating systems and sound.

Description: An analytical study of the dynamics of vibrating systems including free, forced, damped, and coupled simple harmonic motion; vibrations of strings, bars, membranes, and diaphrams. A development of the acoustic wave equation. Propagation of plane waves through pipes and between different media. Propagation of spherical waves including radiation from pulsating sphere and circular piston.

Prerequisite: Ma-104.

PHYSICS (Applied Acoustics) 3-0 Ph-422

Objective: To continue the study of sound begun in Ph-421 and to apply theory to certain practical problems.

Description: An analytical treatment of acoustic resonators; acoustic impedance; effects of branches, orifices, and viscosity on propagation of plane waves through pipes; horn, loud speaker, and microphone theory and practice. Fundamentals of acoustical measurements including rating and calibration methods of microphones and loud speakers. Architectural acoustics. Fundamentals of hearing.

Prerequisite: Ph-421.

PHYSICS (Underwater Acoustics) 2-3 Ph-423

Objective: To apply the theories developed in Ph-421 and Ph-422 to design and operation problems associated with underwater sound equipment.

Description: An analytical treatment of the piezoelectric effect and the magnetostriction effect with applications to sonar transducers and to crystal oscillators. Transmission of sound in sea water including problems of refraction, attenuation and reverberation. Physics principles and electronic circuits used in design and operation of modern sonar equipment. Experiments in acoustical measurements, sound beam and sonar equipment measurements, operation of sonar equipment.

Prerequisite: Ph-422.

PHYSICS (Sonar Systems) 2-4 Ph-424

Objective: To acquaint the student through study of modern sonar equipment with design and operational problems of such equipment.

Description: Various types of sonar equipment are studied in the laboratory (Sonar Barge) and in the classroom.

Prerequisite: Ph-423.

PHYSICS (Kinetic Theory) 3-0 Ph-540

Objective: To present the basic principles of the kinetic theory of gases.

Description: Properties of an ideal gas, distribution of molecular velocities and energies, equilibrium, Maxwell's law, evaporation, mean free path, collision cross section, scattering, Fermi-Dirac and Einstein-Bose statistics, thermionic emission.

Prerequisites: Ph-113 or Ph-140 or Ph-153; Ma-103 or Ma-183.

PHYSICS (Atomic Physics) 3-0 Ph-610

Objective: To familiarize the student with the principles of atomic physics.

Description: Elementary charged particles, photoelectricity, X-rays, radioactivity, atomic structure, nuclear disintegration.

Prerequisites: None.

PHYSICS (Modern Physics) 4-0 Ph-631

Objective: To familiarize the student with some of the problems in modern physics.

Description: Charges and masses of elementary particles, photoelectricity, X-rays, wave mechanics, nuclear structure and nuclear particles, physics of the solid state.

Prerequisites: None.

PHYSICS (Atomic Physics) 3-3 Ph-640

Objective: To familiarize the student with the principles of atomic physics.

Description: Elementary charged particles, photoelectricity, X-rays, radioactivity, atomic structure, nuclear disintegration.

Prerequisites: None.

PHYSICS (Theoretical Physics) Ph-731

Description: Topics in theoretical physics selected to meet the needs of the student.

PHYSICS (Theoretical Physics) Ph-732

Description: Topics in theoretical physics selected to meet the needs of the student.

PART IV

Groups Commencing Post Graduate Education Away from Post Graduate School

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GROUPS COMMENCING POSTGRADUATE EDUCATION AWAY FROM THE NAVAL POSTGRADUATE SCHOOL

Group Designation	Curriculum	Location
G	General Line	Newport, R. I.
NB	Naval Construction and Engineering	Mass. Inst. Tech.
NB2	" " " "	" " "
NB3	" " " "	" " "
ZG	Civil Engineering	Rensselaer Poly I.
ZG2	" "	" " "
ZHW	Law at George Washington	George Washington U.
ZH2W	" " " "	" " "
ZH3W	" " " "	" " "
ZHG	Law at Georgetown	Georgetown U.
ZH2G	" " "	" "
ZH3G	" " "	" "
ZI	Naval Intelligence	Anacostia, D. C.
ZK	Advanced Man. (13 weeks)	Harvard U.
ZKH	Business Admin.	" "
ZK2H	" "	" "
ZKS	" "	Stanford U.
ZM	Textile Eng.	Lowell Inst.
ZM2	" "	" "
ZPN	Personnel Admin. and Trg.	Northwestern U.
ZPO	" " " "	Ohio State
ZPS	" " " "	Stanford U.
ZT	Man. and Ind. Eng.	Rensselaer Poly I.
ZU	Religion	Various

CIVIL ENGINEERING CURRICULUM

Two years of Postgraduate Training at Rensselaer Polytechnic Institute, Troy, New York.

Sucessful completion of this course normally leads to appointment in the Civil Engineer Corps.

	First Year	Math. Mech. Survey
7.03	Elec. Cir.	3(4)
17.16	Str. of Mater.	4(6)
10.11	Eng. Geology	3(4)
		10(14)
5.05	Photogram.	2(3)
12.38	Heat Eng.	3(3)
7.60	Elect. Mach.	3(4)
12.25	Hydraulics	3(5)
5.76	Ele. Str. Analysis	3(5)
9.21	Applied Composition	3(4)
5.78	Reinf. Conc. I	3(5)
		29(29)
7.64	Trans. and Dist.	3(4)
12.42	Heat and Vent.	2(3)
5.77	Timb. and Weld. St. Str.	3(5)
5.80	Stress in H. and R.R.	3(5)
5.79	Reinf. Conc. II	3(5)
5.75	Bldg. Construction	3(5)
5.32	Soil Mechanics	3(5)
		20(32)

	Second Year	Summer Survey
5.81	Brdg. Anal. and Des.	3(5)
5.86	Arch. Plan. Prin. (CEC)	3(5)
12.48	Power Plants	M.E.2(3)
7.69	Theory (CEC)	E.E.2(3)
		10(16)
5.82	Indet. Str. I	3(5)
7.72	Util. of E.E. for Naval Estab. (CEC)	3(5)
5.09	Specifications	2(2)
12.48	Personnel Mgmt. and Indust. Relations (CEC)	3(4)
13.54	Met. and Weld	4(6)
5.35	Foundations	3(5)
		18(27)
G5.82	Wharves and Dry Docks	3(3)
5.59	San. Eng.	4(7)
5.15	High. and Air.	4(6)
G12.47	Power Plant Design (CEC)	M.E.2(3)
7.08	Power Plant Design (CEC)	E.E.2(3)
	Thesis	4(10)
		19(32)

GENERAL LINE

One year graduate training at Newport, R. I. and Monterey, Calif.

OBJECTIVE

The objective of the General Line Curriculum is to care for the pressing need to indoctrinate, specifically train, and broaden the professional knowledge of the large number of transferred reserve and temporary officers and of Naval Academy graduates, who, during the past few years, have served in specialized assignments, and to prepare officers having three or four years of narrow experience for the early assumption of broader responsibility aboard ship.

CURRICULUM

Subject	1st Term	2nd Term	3rd Term	4th Term	Total Hours Per Year
Strategy & Tactics	3	3½	3½	3	130
Communications	2	2	2	2	80
Logistics	2	2	2	2	80
Electricity & Math*	5	5	5	5	200
Ordnance & Gunnery	4	4	4	4	160
CIC-ASW	5A	5B	5C	5D	50
Administration & Leadership	2CD	2CD	2AB	2AB	40
Naval History	1C	1D	1A	1B	10
Foundations of National Power	2B	2C	2D	2A	20
Military Law	4B	4C	4D	4A	40
Naval Intelligence	1C	1D	1A	1B	10
Aviation	2AB	2AB	2CD	2CD	40
Naval Engineering	4CD	4CD	4AB	4AB	80
Damage Control	4C	4D	4A	4B	40
Seamanship	3D	3A	3B	3C	30
Navigation	4AB	5AB	4CD	5CD	90
Meteorology	2D	2A	2B	2C	20
Submarines	½AD	--	½BC	--	5
Seamanship P.W.					10
			TOTAL HOURS		1135

* Mathematics 40 hours of first term

NOTE: The student body is divided into four (4) equal groups (A,B,C,D,) to facilitate scheduling.

NAVAL CONSTRUCTION AND ENGINEERING CURRICULUM

A three year course at Massachusetts Institute of Technology at Cambridge, Massachusetts, successful completion of which normally leads to designation of Engineering Duty Officer.

Although the curriculum is designed to qualify the student generally for naval construction and engineering assignments, selection of courses is such as to offer advanced work in any one of the following:

Basic Hull Design and Structures
Marine Electrical Engineering
Fuels, Combustion, High Temperature Materials and Corrosion
Power Plants (Turbines, etc.)
Hydraulic Machinery, Propellers, and Lubrication
Ship Habitability
Internal Combustion Engines (Diesel)

Quotas for the above specializations are determined by the Chief of the Bureau of Ships.

The three year course may be shortened to two years for students having exceptional scholastic background.

All curricula lead to a Master's Degree in Naval Construction and Engineering. Details may be found in the annual Massachusetts Institute of Technology Bulletin.

LAW

Three years of graduate work for selected officers of the Navy in the LAW SCHOOL of George Washington University or Georgetown University.

Considerable latitude is allowed in the exact curriculum followed by the student officer within the framework essential to receiving a degree in law at the university in question. Studies at the Law School are supplemented with work in the Office of the Judge Advocate General of the U. S. Navy.

NAVAL INTELLIGENCE

Twelve to twenty seven months at Anacostia, D. C.

Objective: To train Naval Officers selecting Intelligence as their specialty, in all phases of Intelligence. To conduct intensive instruction in foreign languages to meet the Navy's need for linguistic officers.

CURRICULUM

The student spends six months at the school studying intelligence subjects, then ten weeks at field work with the fleet is undertaken; and finally, a period of from three to eighteen months is spent at the school studying a foreign language. The degree of difficulty of the language determines the length of the final period.

ADVANCED MANAGEMENT

A thirteen week course conducted twice each year, in February and September, by the Graduate School of Business Administration, Harvard University.

The method of instruction is by means of research studies involving inquiries of several companies or perhaps an industry, and case studies collected from specific business organizations.

The study program is divided about equally among the following subjects:

(a) Administrative Practices
(b) Cost and Financial Administration
(c) Production Management
(d) Marketing Management
(e) Problems in Labor Relations

At present this course is made available to only a few selected naval officers of the rank of Commander or above and departmental quotas are determined by the Bureau of Personnel.

BUSINESS ADMINISTRATION CURRICULUM

A two-year course of Postgraduate instruction conducted at the Harvard Graduate School of Business Administration and at the Stanford University Graduate School of Business.

Objective: To develop the ability in officers to analyze business organizations, problems, and conditions; to acquire an appreciation for and an understanding of business as a whole; and to administer effectively future assignments which may require personal dealings with business and industrial concerns or utilization of business techniques.

University bulletins should be consulted for details of the curricula. In general, officers take courses recommended by faculty advisors at the two schools. The advisors are in close contact with representatives of the various technical Navy Department Bureaus which have officers enrolled and endeavor to have student officers take courses best suited to the respective Bureau's requirements. The curricula outlined below are samples only and are purposely made sufficiently flexible to meet varied requirements:

STANFORD

FIRST YEAR

Autumn Quarter

Sources of Business Administration
Business Reports
Business Economics
Management Accounting
Business Organization

Winter Quarter

Cost Acounting
Business Finance
Business Statistics
Business Psychology

Spring Quarter

Business Finance
Business Forecasting
or
Applied Business Statistics
Marketing I
Industrial Management I

HARVARD

FIRST YEAR

Autumn Semester

Single Course, Elements of Administration, divided into six parts:
Production
Marketing
Finance
Control
Administrative Practices
Public Relationships and Responsibilities

Spring Semester

Continuation of same divided single course as outlined in Autumn Semester.

BUSINESS ADMINISTRATION CURRICULUM (Continued)

STANFORD

SECOND YEAR

Autumn Quarter

Auditing
Marketing
Industrial Management
Retail Store Management
or
Production Engineering

Winter Quarter

The Law of Contractual Relations
Production Management
Purchasing
Accounting Organization and Comptrollership
Market Research
or
Personnel Administration

Spring Quarter

Business Forecasting
or
Interpretation of Business Data
Industrial Cost Control and Budgeting
Accounting Problems
Quality Control of Statistical Methods

HARVARD

SECOND YEAR

Autumn Semester

Administrative Policy I
Industrial Accounting I
Transportation
Industrial Procurement

Spring Semester

Administrative Policy II
Industrial Procurement
Industrial Accounting II
Personnel Administration

TEXTILE ENGINEERING CURRICULUM

Two years of graduate work for selected officers of the Supply Corps at Lowell Textile Institute at Lowell, Massachusetts.

Inasmuch as student officers are allowed a considerable discretion in the selection of course pursued, dependent upon their individual background, it is impractical to reproduce here all the courses offered at Lowell Institute and available to officers of the Supply Corps. Courses are offered which lead to Master's degrees, provided the student has adequate educational background to pursue them satisfactorily.

Details may be found in the Annual Curriculum Bulletin of Lowell Textile Institute, available from that institution upon request.

PERSONNEL ADMINISTRATION AND TRAINING CURRICULUM

A five-quarter (15-month) course of instruction carried on at three Universities, Ohio State, Northwestern, and Stanford.

The curricula at the different universities differ in themselves and are adaptable to the individual backgrounds of the students concerned. Considerable elective make-up of personal curricula is allowed and so the course outlined below should be considered as illustrative of the general coverage of the course rather than accurate as to the details, which vary from University to University and between individual students.

Summer Quarter, 1948

Advanced Organization D1	3
Personnel Administration	4
Business Statistics	4

1st Quarter, 1948-1949

Tests and Measurements C18	4
Business Statistics II	4
Psychology Seminar E2	2
Management Seminar E2	2

2nd Quarter, 1948-1949

Special Abilities C19	4
Psychology Seminar E2	2
Management Seminar E2 & E3	2
Problems in Personnel D4	4

3rd Quarter, 1948-1949

Social Motivation C13 or	4
Interviewing and Classification C26	3
Psychology Seminar E2	2
Management Seminar E3	2
Motion and Time Study C11	4

Summer, 1949

Seminar in Psychological Problems or Seminar in Industrial Psychology	3
Independent Study, Management D99	3
Thesis	6

MANAGEMENT AND INDUSTRIAL ENGINEERING CURRICULUM

One academic year at Postgraduate Education at Rensselaer Polytechnic Institute, Troy, New York.

Latest BuPers Circular Letter on "Applications for Postgraduate Training" should be consulted to determine eligibility.

First Term

Cost Analysis and Control	3-5
Motion Economy in Industrial Production	3-5
Production Planning and Control I	3-5
Personnel Organization and Management	3-4
Thesis	3-0
	15-19

Second Term

Statistical Analysis	3-5
Industrial Performance Standards	3-5
Production Planning and Control II	3-5
Industrial Relations	3-4
Thesis	3-0
	15-19

This course leads to a degree of Master of Science. (Undesignated)

RELIGIOUS CURRICULUM

Selected chaplains are enrolled each year in institutions of their own choice to pursue advanced studies in religious and pastoral subjects. The choice of subjects is left largely to the individual concerned; courses vary widely from college to college depending upon the previous background and denominational training of the chaplains concerned. Some detailed information on the various colleges and universities offering courses may be obtained by writing to the Chaplains Activity of the BuPers.

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